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Machine Forgings

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Editor, American Machinist

Machining and material are saved as the result of increased accuracy in the art of forging

ASIDE from cost, the great difference between hand and machine forgings may be said to be the excess of metal left by the old method. True, we had blacksmiths who could forge close to size, but in most cases, the extra time and heat required made it cheaper to leave plenty of stock and to remove the excess by machining. Hence the development of heavy forging lathes, capable of taking deep cuts to get below the irregularities of the forging at the first pass. This extra stock was also found on power forgings made without dies.

Drop-hammer forgings, with dies that shape the metal into a fairly close approximation to the desired form and size, were a great step forward. And modern drop forgings are much improved over those of earlier days. But in general practice, drop forgings have a substantial flash, which must be removed by trimming dies before machining, and machining allowances, which add to the waste of material.

For some classes of work the "squeeze" or hot-pressing method is replacing or supplementing the drop forging of yesterday. Some designate all these as "upset" forgings. In some cases, the heated end of a bar is placed in the forging machine, clamped, and the end upset or forged to any desired shape in the dies. Bolt heading is perhaps the simplest example of this. In other forgings, the material is cut off in lengths containing the amount of metal needed and with as little surplus as possible. These blanks are heated, placed in the die, and formed by pressure to the shape desired. Almost no finishing is required, $\frac{1}{32}$ in. on a side being ample in many pieces. The elimination of excess metal saves both in material and in the cost of removing it.

Another interesting development is the now common method of forging rings by upsetting stock the size of the hole desired. A punch of approximately the same diameter as the bar, from which the upset piece is made, makes the hole while the slug, which would have been wasted by the old method, remains part of the bar itself and avoids waste of material.

The forging machine has been developed from small beginnings to the massive machines that now handle stock up to 7 or more inches in diameter. Daring designs, coupled with high-tensile castings, alloy steels for shafts and tie-rods, and better material for dies, have made possible even fairly large forgings that are astonishingly accurate.

For centuries men have admired the handiwork of the blacksmith, and historians of all ages have recorded his prowess in the shaping of metals. Now, instead of exercising extreme craftsmanship on each piece, the ingenuity and skill has been transferred to the making of the die. Not only have we learned how to squeeze hot steel into shapes far different from the original form but so to guide the transition that the flow of the metal preserves, or even increases, the original strength. The diemaker has replaced the blacksmith, and the forging machine makes it possible to reproduce the results of his skill on thousands of duplicate forgings, more accurate than the greatest blacksmith of old would have believed possible. Often the forging is completed

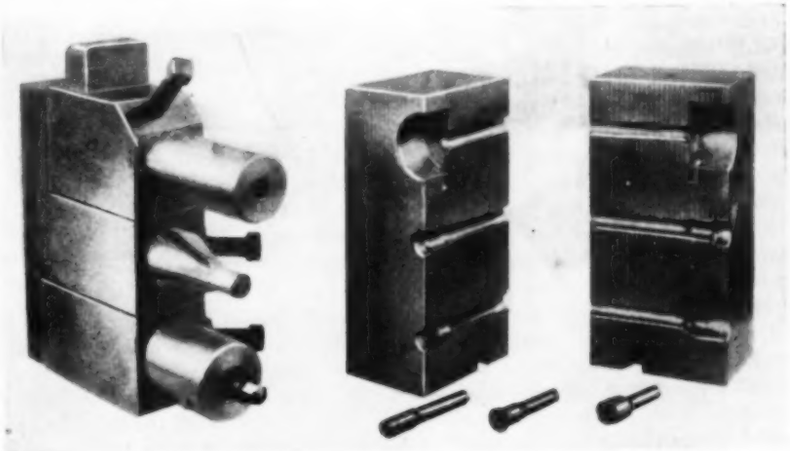

Fig. 1—Three sets of dies complete a hexagon socket wrench with a minimum of waste material

at a single heat, and even fairly complicated shapes are produced without welding.

It is probably safe to say that, in its simplest form, upset or pressed forging uses bar stock of the minimum diameter of the piece to be made and upsets the end to gather the material for the enlarged portion. Hence the name of the process. A simple example is seen in Fig. 1, which shows the punches and dies for a small hexagon socket wrench. Bar stock is clamped in the upper die with the end projecting sufficiently to gather the necessary amount of stock in the end of the upper die (at left). At the next stroke of the press, the bar with its enlarged end, is further upset (center), by the middle punch. When this bar is placed in the lower die, the hexagon punch not only makes the proper opening in the end of the wrench but also forces the metal to fill the opening in the die and squares the end. With the die properly designed and made and the bar inserted to the proper distance, which is determined by a suitable stop, there is practically no flash, or waste of metal. With the metal in a plastic state and with suitable dies and pressure, steel can be made to flow in much the same way as putty or the softer metals.

Little Waste

A more complicated forging is seen in Fig. 2, this being a side gear for a differential mechanism. The opening in the first punch upsets the end of the bar to secure sufficient metal for making the gear. This punch does not, however, shape the metal to its own exact form but rather makes a shoulder and starts the metal flowing as at *A*. The second operation upsets the blank, as at *B*, and forms the bevel on the edge. The third die is enlarged at the base to allow for the metal to flow so as to form the hub when the spreading punch in the third die forces the metal back to fill the hub space. With the hub formed, it only remains for the last punch to extend the hole to the length of the hub and to complete the forming of the metal to fill the hub cavity in the die. When the finished forging is cut from the bar, the only waste of metal is shown by the slug *C*.

Forgings may now be divided into two classes—rough and finish. While there are few cases where an accurate piece is completely finished in the forging machine or press, modern practice produces forgings with only a few thousandths left for grinding. Parts with shanks or stems can now be forged without draft so that a uniform amount of material is left for grinding. Mechanical knockouts, that force the piece out of the die, make a draft or taper unnecessary, even on such long slender parts as motor valve stems.

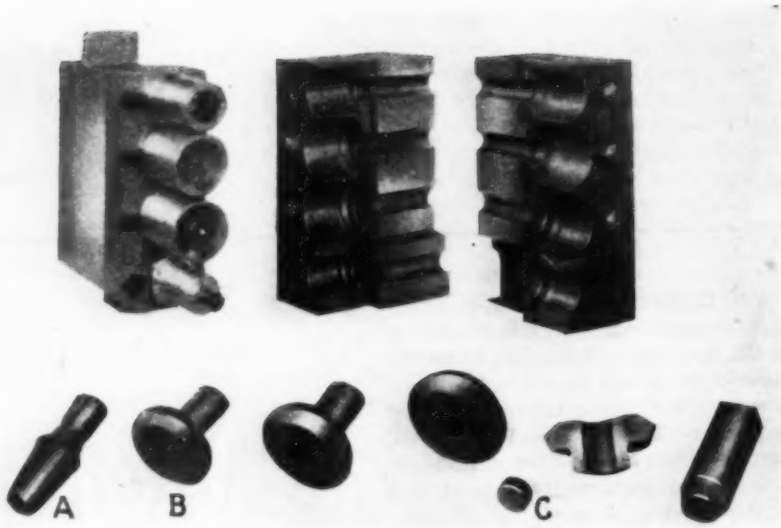

Fig. 2—Slug *C* is the only material lost in making this differential gear forging

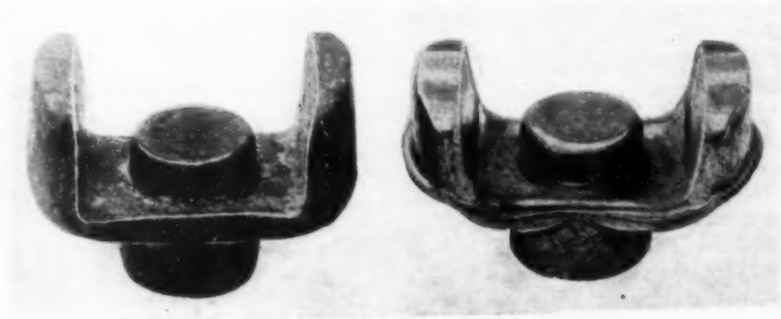

Fig. 3—In making this universal joint yoke, the forging machine supplements the drop hammer

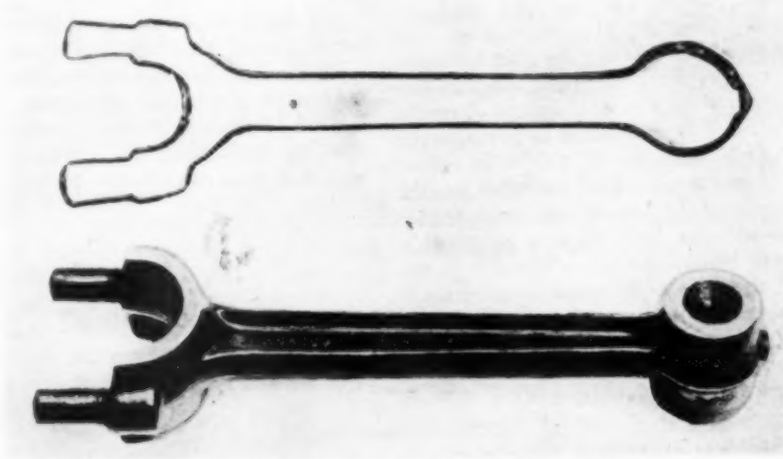

Fig. 4—Restriking in a motor driven press gives a finished connecting rod without machining

While in many places the forging machine has replaced the drop hammer, in others it supplements the hammer as a finishing operation. An example is the forging for the universal joint in Fig. 3. A clean forging comes from the drop-hammer die and is then finished to dimensions in the forging press (at right). It is so close to size that no machining is required except to drill the necessary hole.

In some cases, the second or finishing operation can be done at the same heat

or before the drop-forging cools below the flowing point. Pressure finishing or coining is also done cold after trimming. Forgings can be coined to close tolerances. Some forgings are normalized after trimming and then pressed to size. Fig. 4 shows an example of this in the shape of a connecting rod with the cap bolts forged on the rod itself. The excess volume of material caused by the final pressing is shown in the small flash from the second trimming. Such a rod is in the "finished-all-over" class without the usual milling or other machining of the sides, ends and edges. These rods are restruck in a motor-driven press with an increase in production of over 140 per cent above that of a hammer.

A good example of hot pressing to eliminate rough machining a ring gear is seen in Fig. 5. The rough blank at the left is formed by welding, hammering, upsetting, or as desired. At the right is the same blank after hot pressing to form with only a light finish turning necessary before cutting the gear teeth.

Many parts can be pressed to close dimensions from forged or cut blanks; a few examples are shown in Fig 6. Forging, however, requires a careful study by an experienced man before deciding on the advisability of the process. Either the shape of the finished part or lack of proper equipment may prevent securing the desired result.

Coining, or cold pressing, as a method of finishing drawn steel parts is becoming common practice and has two distinct advantages. It finishes the part to size by flowing the metal to the desired contour, and as the pressure required gives a permanent set to the metal, further changes of shape or distortion are largely eliminated. Steel brake drums, housings of various kinds, and many other parts are now finished in this manner.

Malleable iron parts are also being finished by pressure in the same way. Forming the bosses and lugs on the casting in Fig. 7 is a good example of work of this kind. Besides forcing these three surfaces into proper relation with each other, the pressure corrects all warping or distortion and saves machining. As in the metal work, already referred to, the compression beyond the elastic limit of the material insures against further changes in shape.

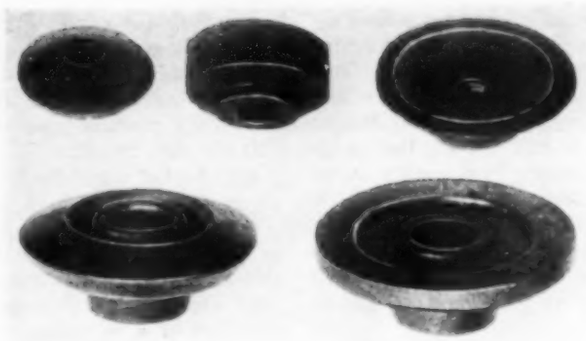

Fig. 6—Other examples of hot pressing show what can be accomplished in this direction

Fig. 7 — Malleable castings, too, may be straightened and the bosses formed by pressure

Both upsetting and extrusion are used in making parts with shanks or stems, such as valves for motors and similar pieces. There is little if any difference in the final product as both are good. But, according to some, the wear of the dies used in extrusion is a serious matter and makes upsetting the more economical method. Where the stem is a small part of the volume of a piece, extrusion seems the better way. Here the piece at left, Fig. 8, is made by the upsetting method while for that at the right, the small stem is extruded from the large mass of metal in the head or body. With motor valves it is considered good practice first to upset the head on the stem and then finish the valve, including the seat to the grinding allowance.

These examples are given through the cooperation of the National Machinery Company.

Another very interesting development in machine forging is the making of steel cylinders for airplane engines. Originally bored and turned from solid billets with a waste of over 80 per cent of material, as well as time, these were next made from steel tubing, and then extruded. The latest method is to utilize the forging machine. The process, shown in Fig. 9, is from the Canton Drop Forging & Mfg. Co., using a 7½-in. National machine. The bar used is the approximate diameter of the cylinder bore, and is upset in the first three stages shown. The fourth pass punches out the end as at the bottom, leaving the bar ready for the first upset on the next cylinder.

This process produces a highly desirable grain flow that secures maximum strength in the flange, and it has re-

Fig. 5—Hot pressing transforms the rough blank at the left to the finished blank at the right; little metal need be removed before the gear is cut

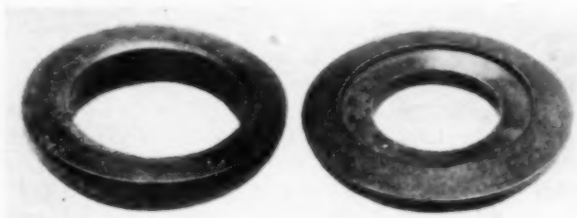

Fig. 8—When the boss is large as at the left, upsetting is usually used; but for a small stem as at the right, extrusion may prove preferable

duced the weight of forgings something more than 50 per cent. These forgings minimize the machining necessary and give a very uniform hardness of the surfaces. This averages about 187 Brinell on the outside and 212 on the inside for SAE 1050 steel. Parts are air cooled after forging from a temperature of 1650 deg. F. Greater hardness can be secured by using forced draft cooling. Cylinders are also made of SAE 4140 and heat-treated to give a Brinell of 351 to 377.

Ask a dozen forge men what steel to use for die-blocks and the chances are

Airplane engine cylinders are now forged from a bar in the stages shown

that you will get at least ten different answers. However, this is an indication that a number of steels are available that give good results in this trying service. One forge man uses carbon steel of from 0.40 to 0.60 per cent carbon and 0.60 to 0.80 manganese for work that is not too hard or where the service is not so continuous as to overheat the dies. He also uses nickel-chrome and nickel-chrome-molybdenum for many classes of work.

For bolt and nut machines of the squeeze type, where the dies run to temperatures of 900 to 1,000 deg. F., he uses nitrided steels, but does not find that these stand the shock of hammer blows satisfactorily.

Dies for cold pressing or coining are made of cobalt steels, these being air-hardened at 1,800 to 1,900 deg. F. They stand heavy pressures and have from 10 to 12 times the life of ordinary steel for this kind of work.

Cobalt-tungsten steels are used for building up the edges of deep-drawing dies. This greatly reduces the wear on the vital point, the rest of the die being made of ordinary steel. Forming dies are usually made of plain steel, such as 0.60 per cent carbon.

Dies for hot work should be tempered at or about the highest working temperature. Carbon steels of 0.50 to 0.60 per cent are considered satisfactory for this class of work. Tungsten-chrome steel, according to this authority, runs about $0.40 a lb.; chrome, $0.30, and nickel steel at $0.20, varying to some extent. He feels that the cost is justified in cases where they are needed. Experience indicates that about 20 per cent of the dies in use are of plain carbon steel, the remainder being various alloys of nickel, chrome and molybdenum.

Making Dies

The making of dies is one of the problems in all kinds of forging. Die "sinking," in which the metal is cut away by machines of the milling family is the older method. Then there is the "hubbing" or "typed" method by which a master form is driven into the hot die blank. The method is not new, as silver hollow ware makers have used it for years, but its adoption for forging dies is fairly recent. Ford uses this method extensively.

The "hubs" or "types" are made of steel with 0.47 to 0.55 carbon, 0.50 to 0.60 manganese, 0.6 to 0.75 chromium, 1.50 to 1.75 nickel and 0.10 to 0.20 silicon. Sulphur and phosphorus must be less than 0.03 per cent. The hubs are made enough larger than the piece wanted to allow for two shrinkages, that of the die and of the forging, and are hardened.

Die blocks are made of regular die-block steel and heated to from 1,700 deg. F. to 2,100 deg. F. for striking. When the impression is deep, the blocks are sometimes roughed out to lessen the work to be done by the hub. A 90-ton ram press or 2,500-lb. steam hammer is used.

When the dies are to be used in a forging machine, they are made from regular 3.5 per cent chrome steel with 0.60 to 0.75 carbon, 0.30 to 0.40 manganese and 0.10 to 0.20 per cent silicon. Trimming dies are first hubbed and then cut out. Scale is prevented by heating in a lead bath or in a furnace having a controlled atmosphere.

Before heating, the die blocks are ground to remove decarbonized metal and covered with plain salt (sodium chloride). While this melts at 1,400 deg. F. it leaves a protecting film up to 2,100 deg. F. and is easily scraped off just before the block is hubbed. After the impression has been hubbed the face is covered with a layer of fine charcoal or cast-iron chips.

The degree of heat must be quite accurate in order to allow for expansion and contraction, and its effect on the size of the finished piece.

Typed inserts are also frequently made for large dies, which are shrunk into place at about 850 deg. F. A shrinkage allowance of 0.0025 inch per inch of die has been found adequate. As the hub sometimes "grows" with repeated heating it is checked for size after each 10 dies have been formed.

Master hubs are also made in the same manner by making a super-master die which is used to hub a master hub, this master being used in turn to hub dies. The shrinkage must be carefully considered in each case.

Master hammer dies are also made from the super-master. The only difference between these and production dies is the shrinkage allowance. They allow for three shrinks, the master hub, the forging die and the forging itself. A master hammer die will make 500 good hubs, and each hub should make from 200 to 1,000 dies, depending on the shape and depth. Hubbed dies are claimed to produce 25 per cent more forgings than cut dies because of the more dense surface produced.

While the speed with which hot metal is forged has its effect on the amount of power required, the variation is not as marked as might be expected. Tests by Prof. W. Trinks in rolling mill work indicate that the resistance to change of shape increases with the speed up to a certain point, but remains constant beyond that speed. He concludes that at normal working speeds the stress is not materially affected by an increase in the speed of the press.

Cast Iron in the Shop

Discussion

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Fabricated steel, as pointed out by John R. Godfrey (*AM*—Vol. 76, page 1044), has definitely established its vogue. For certain uses, cast iron has been superseded, and the iron founder would do well to analyze these instances.

Often the supplanter has been more alert and more versatile. Material has been used to better advantage in design and in manufacture. Weights have been reduced and patterns have been obviated.

But let the foundryman remember that his field is still wide and that design can be enlisted on his behalf. His material and methods can be improved.

Machining With Oxyacetylene—I

H. H. MOSS

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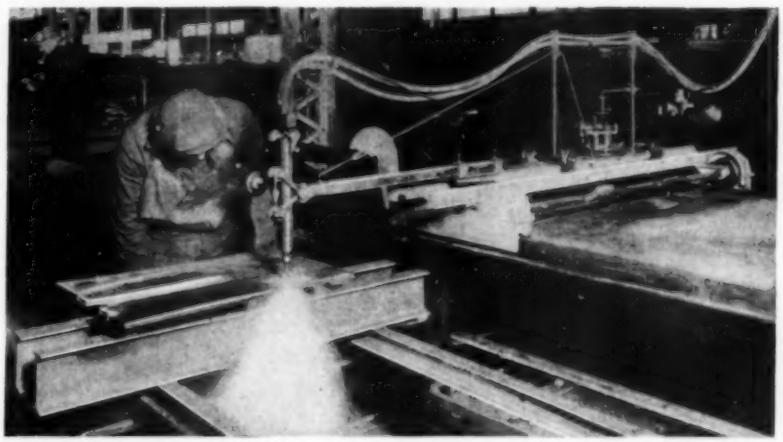
New developments in tangential flame application have advanced torch operations beyond those of simple cutting

UNTIL a few years ago, oxyacetylene cutting was used primarily as a severing tool. In this capacity, it performs a wide variety of cutting operations in all commercial thicknesses and at low cost. In a number of respects, particularly those relating to cuts of irregular contour in rolled or forged steel, this process has developed to be of unprecedented utility, being capable of tracing, singly or in multiple, intricate geometric shapes or patterns within narrow tolerances.

The accurate performances of this new cutting tool in the heavy gages has earned for it credit of having greatly expanded their commercial range, for it has enabled economical preparation of these heavy gages for fabrication, thereby encouraging their use in fields hitherto closed, such as machinery housings, major pressure vessels, structural slabs and plates.

This cutting may be characterized as normal cutting or severing because the cut is generally made through the part as at *A* Fig. 1, leaving edges in a plane 90 deg. to the surface of the part cut, except where a bevel cut is particularly sought. The scope of normal cutting has grown to a degree where it is more proper to refer to it as "Flame Cutting," for it is as essential to the art of metalworking today as any of the allied primary formative operations and is as extensive in its applications.

Also utilizing the oxyacetylene cutting principle, another process has begun to take shape, a sequel of the former. Its main distinction is its use of a tangential positioning of the cutting oxygen stream as at *B* Fig. 1. This change in the position of the cutting oxygen stream is responsible for an entirely new range of



A steel housing for mechanical shears shape-cut from plate

oxyacetylene cutting operations. Because of their similarity to many operations of customary tool machining, these operations have been collectively termed "Flame Machining" in contrast with "Flame Cutting."

Fig. 2 classifies the applications of oxyacetylene cutting. It is divided into two main branches, "Flame Cutting" and "Flame Machining," within which are subtended the respective applications, both commercial and experimental, within present range. On the left of the diagram under "Flame Cutting" are arranged those operations whose elementary function is largely that of linear oxidation. With the exception of rivet cutting, their performance results in a relatively narrow slot or kerf varying in width as the depth of the part cut, as the diameter of the cutting oxygen nozzle and as the oxygen pressure during the cutting operation. This width is approximately $\frac{1}{8}$ in. and less for the light gages, and $\frac{1}{2}$ in. or more for heavy and unwieldy masses of steel. Over the range of $\frac{1}{2}$ in. to 6 in. thickness, the kerf width for guided cuts varies between plus or minus $\frac{1}{32}$ in. and $\frac{3}{32}$ in.

The rate at which the cut is made varies primarily as the thickness, if the cut is perpendicular to the surface of the part being cut. If not, the rate will

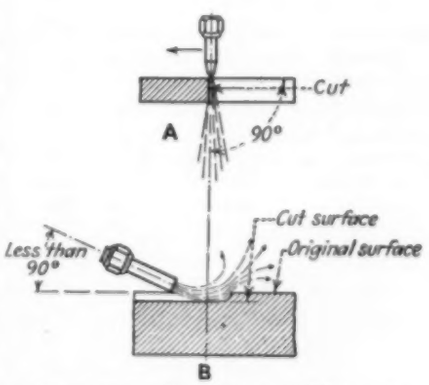


Fig. 1—A change in position of the cutting flame opens a new field of application

The first of two articles based on a paper presented before the American Welding Society at Buffalo, October 3, 1932.

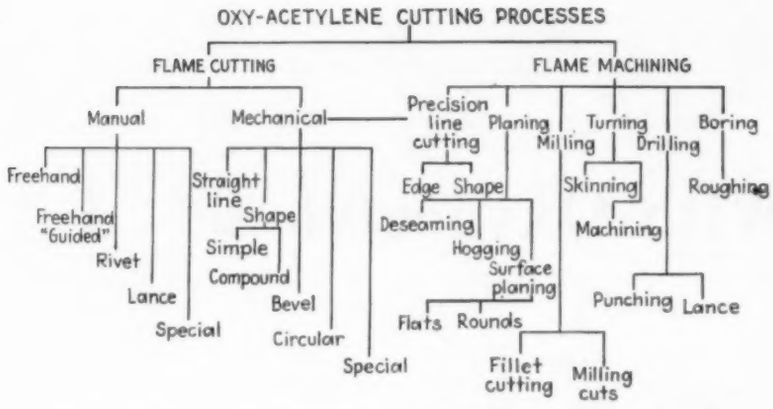


Fig. 2—Under two main heads the cutting operations are classified

vary as the cross sectional area of the cut. The rate is usually expressed in terms of linear feet per hour. Data for manual and mechanical operation of the cutting tool for thicknesses from ¼ in. to and including 12 in. are shown in Table I. From the more fundamental viewpoint, the rate measure, pounds of metal removed per unit of time, though somewhat difficult to summarize, is quite useful for purposes of comparison as will later be indicated. Therefore, Fig. 3, which is an approximate construction of these relationships, has been prepared to indicate the number of pounds of metal removed per hour on the basis of normal kerfs and the identical range of manual skill as expressed in Table I.

The residues of normal cutting are composed largely of iron oxide in the form of the magnetic oxide Fe_3O_4, and iron or steel which has been blown from the kerf in the molten state, the latter usually increasing as the thickness of the part cut.

The oxygen expense of normal mechanical cutting, exclusive of that expended in the preheating flames of the cutting nozzle, varies approximately between 3½ and 6 cu.ft. per lb. of metal removed. The relation is expressed in Fig. 3 by the consumption curve from

TABLE I

Rate of Linear Travel in Straight-Line Cutting of Low-Carbon Steel Plate

Thickness of Metal, Inches	Speed Range in Linear Feet per Hour	
	Manual	Mechanical
¼	90–140	107 –140
½	83–130	89 –130
1	50– 71	64 – 95
2	33– 46	44 – 60
4	18– 27	30 – 43
8	11– 19	21 – 27½
12	6– 13	13½– 14½

NOTE: The range in speeds given in this table represent the nominal differences in efficiency of unskilled and skilled workmen, conditions of material and facilities for the performance of the work.

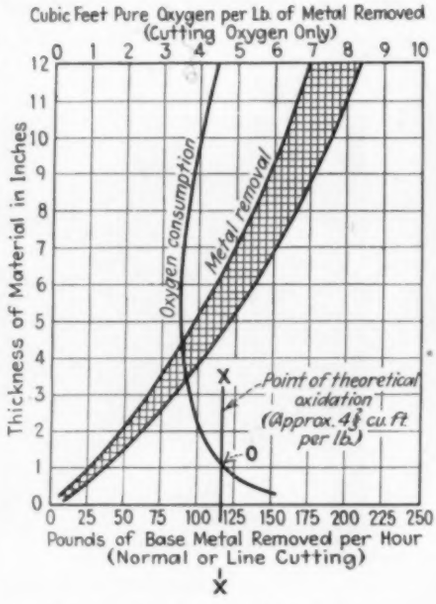

Cubic Feet Pure Oxygen per Lb. of Metal Removed
(Cutting Oxygen Only)
0 1 2 3 4 5 6 7 8 9 10
Thickness of Material in Inches
12 11 10 9 8 7 6 5 4 3 2 1 0
Oxygen consumption
Metal removal
X
Point of theoretical oxidation
(Approx. 4⅜ cu. ft. per lb.)
O
0 25 50 75 100 125 150 175 200 225 250
Pounds of Base Metal Removed per Hour
(Normal or Line Cutting)
X

Fig. 3—Metal removal and oxygen consumption are shown graphically

which it may be observed that, as the thickness of the cut increases beyond the critical point *O*, the greater is the amount of metal removed as molten steel up to the region of thicknesses of approximately 6 in. Beyond this the oxygen loss increases slightly, which causes the curve to incline in the direction of higher oxygen expense. It may also be observed that as the thickness decreases below the critical point, the curve again swings rapidly towards higher oxygen expense. This loss represents free or unutilized oxygen, because of the relatively short path of the cutting oxygen stream through the material as compared with the relatively high velocity of the cutting oxygen. The critical point on the oxygen expense curve has been assumed to be about the point *O* where the perpendicular *X-X* crosses the consumption curve. The line *X-X* is the relative position in the chart

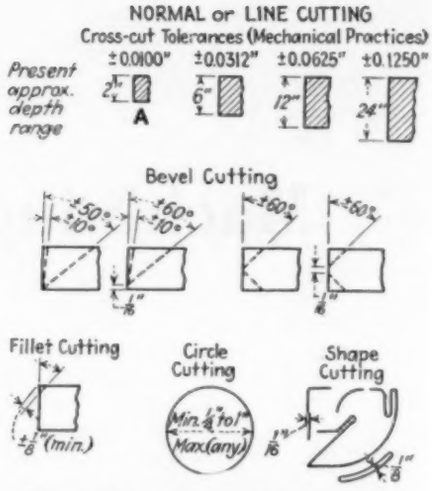
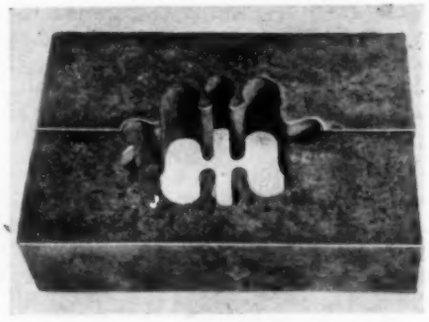


Fig. 4—Line cutting has precision possibilities to the limits indicated

A special part is cut free-hand from steel pipe



An ornamental mold cut from 6-in. plate stock

An example of heavy duty work is this diesel engine connecting rod

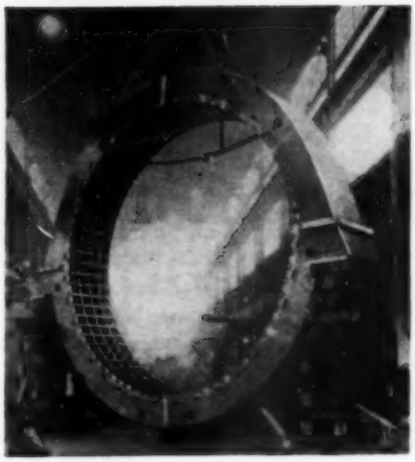
for the point representing the number of cubic feet of oxygen theoretically necessary to oxidize one pound of iron or steel. While it is likely that theoretical oxidation is never accomplished in actual practice, there being some molten steel and some free oxygen in all cutting residues, there is a point in any such chart as Fig. 3 where the effects of these two conditions neutralize and give coincidence with a line representing the theoretical consumption of approximately 4¾ cu.ft. per lb. of steel oxidized. The coincidence occurs in the neighborhood of base metal thicknesses of 3.4 to 1½ in.

Preheating and Annealing

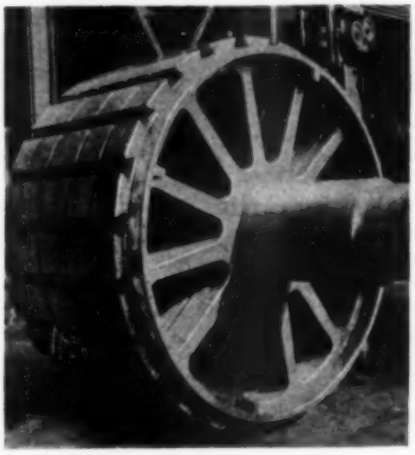
Metallurgically, the effect of flame cutting upon the usual grades of iron and steel is to alter the grain structure about the surfaces cut. This is caused by the rapid chilling usually following the operation. The alteration is highly marginal, but sufficient to increase the hardness of the cut surface unless specific precautions are taken to overcome this. For steels of 0.30 carbon and less, this physical change has been shown to be beneficial because of the toughening action of the heat-treatment. For steels of higher carbon, however, the altered structure sometimes gives rise to fine surface checking, necessitating either the prevention of the hardening effect or its removal after cutting. Preheating of the part prior to cutting or annealing subsequent thereto are both practiced at the present time, the choice being largely a shop matter as long as the specified desired physical properties are not violated. Preheating to a black red is generally more than sufficient, whereas in annealing the metal is required to be heated to beyond its critical temperature in order to restore equilibrium to the grain structure.

For all practical purposes, it may be established that 0.30 carbon is the focal point about which metallurgical concern in flame cutting should occur; the lower carbon bracket is benefited and the higher one requires analysis and the guidance of experience or laboratory direction for assuredly satisfactory results. In either case the economics of flame cutting are proportional, for as the operation becomes more involved, the greater becomes the value of the work accomplished by the cutting operation.

The fact that flame cutting does not impair the commercial value of low carbon iron and steel is responsible for its universal adoption as a tool for conditioning and shaping. However, its vast technical progress in the fields of fabrication results from the accuracy which has been attained in modern cutting practices. These are capable of producing cuts sufficiently uniform with respect to linear regularity and squareness to pass the requirements of final edge finish for innumerable objects of plate and shape construction. Thus it is that flame cutting performs a dual service; severing and finishing.



Ring-shaped plates for a 6250-kva. generator stator were cut on automatic machines so accurately that the separator and yoke feet could be set in place for welding



This 12,500-kva. generator rotor was cut from 22 2½-in. steel plates; its accuracy is shown by the alignment of the spider arms

The depth range of flame cutting would seem to be unlimited. To date, thicknesses up to 8 ft. have been successfully severed. However, it must be remarked that the character and accuracy of cutting does not hold uniform throughout the full depth range. There are three distinct stages. The first, in which the degree of uniformity and squareness of cut is accurate to within a few thousandths of an inch, expressed as precision line cutting at the right of Fig. 2. Its particular range at present, though not restricted to these dimensions, includes all gages up to 2 in. The second stage is that which has been commercialized by mechanical cutting devices of one form or another and includes all gages up to 24 to 28 in. The accuracies of this stage vary from $\frac{1}{32}$ in. for the lighter gages to ¼ in. for the extreme upper end of this range. It is in Stages 1 and 2 that the dual service is performed. The third stage is that which has been developed by manual cutting in one form or another. When done solely by hand blowpipes, its depth is about the same as that of the mechanical range, but requires greater dimensional tolerances; whereas when aided by the oxygen lance, the range is increased indefinitely, to date about 8 ft. These cuts are usually not regarded from the standpoint of surface uniformity, and, therefore, the tolerance of cut is generally of minor consequence.

From the operating standpoint, there are a great number of applications and means whereby to perform them; in fact, too many to embrace in the space available in this article.

With cutting machines developed for practically all general forms of mechanical translation, the present developments in linear flame cutting are largely toward improving the design and construction of the cutting devices for greater cutting accuracy, portability and the widening of the detail range of both the portable and stationary types of semi-automatic and automatic cutting machines.

Flame Machining

On the right hand side of Fig. 2, under "Flame Machining," are arranged those operations whose elementary function, with the exception of two applications, is largely that of surface oxidation much in the form of tool planing. They involve means for removing wide strips or linear areas from the surfaces of steel stock and logically, therefore, classify under a different branch of cutting application from normal or line cutting.

To these strictly machining types of cuts have been added "Precision Cutting" and "Flame Boring," the former being a refinement of mechanical line cutting in the flame-cutting branch and the latter being as yet an experimental development of the ordinary flame-cutting practice of drilling a hole through a piece of work. Their position in the right hand side of Fig. 2 is due to the precise surface obtainable by the former as indicated in Fig. 4 *A* under "Line Cutting" and the accomplishment of a circular hole by the latter without resort to line cutting, much as an ordinary punch produces a hole.

The second and concluding article of this series will appear in *American Machinist* for January 4, 1933.

Limitation of Limits

E. CHAT. SHANKS

Shop standards depend on harmonizing the divergent viewpoints of the engineering and production departments

ONE thousandth of an inch is a definite dimension, but from a mental viewpoint, it may become absurdly large or small. To some, it assumes a magnitude far exceeding its true importance; to others, it seems dwarfed to a point of needless accuracy. These divergent lines of mental attitude are the extremes, but in every shop where close manufacturing is required, they are prevalent in varying degrees. The true dimensional value lies between the two extremes of mental valuation and should be recognized for just what it is. Such recognition will do much toward the harmonious limitation of limits to reasonable requirements, suitable to the product and to the means of producing it.

Three distinct divisions deal with manufacturing limits in most factories: the engineering department, which usually determines fits and tolerances; the production departments, which are responsible for economically manufacturing the product to commercial accuracy; lastly, but probably most important in maintaining the necessary requirements, is the inspection department, which must act as both arbiter and arbitrator.

The designing engineer is likely to look upon 0.001 in. with undue respect since he is dealing with theories and abstract quantities. It is not possible to lay out 0.001 in. upon the drafting board, nor to show correctly the small clearances and interferences which produce desired fits. The designer must visualize these things mentally. Continual use of dimensions in thousandths and in tenths of thousandths tends to increase his mind-picture of such quantities until relative proportions are lost to some extent and he has a tendency to tighten up the limits.

In the production departments, theory gives place to practice, and the shop man realizes just how difficult and costly it is to work to fine dimensions. The dimension, 0.001 in., means a definite amount of material to him, and it is a small amount, presenting difficulties in machining. He fully realizes the inaccuracies of the equipment he must use and its limitations. Further, he knows that in many instances the tolerances are closer than necessary, and this brings about a natural doubt regarding the advisability of other close limits. In consequence, the importances of 0.001 in. becomes dwarfed in comparison to the value placed on it by the designer.

These widely separated viewpoints converge in the inspection department. The inspector usually agrees with the aims of the designer and at the same time realizes the difficulties of manufacturing to minute dimensions. This places him in the position of having constantly to choose between the ideals of theory and the actualities of practice. This choice is often made against his own opinion to prevent the expense of rejection. His decisions are, therefore, frequently inconsistent.

Three Viewpoints

Thus these three divisions in each plant are interested from different angles in the proper setting of allowances and tolerances. Each has a valuable contribution to make in determining what the correct limits are. Each can act as a check on the others and so produce an equilibrium of true values between the divergence of views. This in turn brings about a convergence to a common ground which may be termed the limitation of limits.

Determination of correct limits is a combination of three things: what the engineering department requires; what the shop can produce what the inspection department can maintain. It is obviously unjustifiable to set limits which can be obtained only at excessive cost or which are finer than necessary. It is equally indefensible to require limits that will cause a high percentage of rejection by the inspection department. Careful consideration of true values and thorough investigation of what can be manufactured will prevent such conditions.

On the other hand, the production departments should make every effort to keep the limits of size determined upon. That it is most economical to produce parts which will go together with a minimum of fitting is axiomatic. Those instances where the limits are found to be impractical or too costly should be brought to the attention of the proper authorities for correction—or, if necessary, there should be an alteration in design—rather than be ignored.

The measure of efficiency of the inspection department is not in the quantity of rejections but in the reduction of rejections to a minimum. Therefore, it is especially important that an alert, open-minded and sympathetic attitude characterize all decisions. Acting as arbitrator between the drafting room and the shop, it can bring about limitation of limits to a commercial possibility meeting all requirements. As arbiter of acceptibility, this department should adhere to the limits unwaveringly and consistently. These dual functions of the department, in securing commercial limits and then rigidly maintaining them, will do much toward the establishment of harmonious relations between divisions, reduction of costs and a better product.

The following actual cases, altered only enough to conceal the identities

of the companies involved, prove the need of cooperation in limiting limits. The term "limits" as used includes both allowance and tolerance. Allowance is the amount of clearance or interference; tolerance is the permissible variation beyond the allowance.

Limits Set Too Close

In a certain plant, the setting of limits was assigned to the production engineer. The chief engineer protested and refused to cooperate, placing his own limits upon the drawings. A steel casting, having a reamed hole, was to be placed on the rough turned end of a piece of 2½-in. XX pipe by means of a hydraulic press. Drawings were sent directly to the shop from the drafting room with the hole dimensioned 2.750 in. ream and the turned end of the pipe 2.752-2.753 in. There was an immediate protest from the lathe foreman, through the chief inspector, to the production engineer.

Investigation showed it was necessary to turn the pipe in one cut in order to meet predetermined costs and it was not possible to turn such material closer than within 0.003 to 0.004 in. of round. Obviously both the allowance and the tolerance were wrong; the former because it would not provide the desired fit and the latter because it was impractical to attain. The normal allowance is + 0.0045 in. and the tolerance + 0.0015 in. more (*American Machinists' Handbook*, Third Edition, page 362), but because of the nature of the materials and the means of assembly, this allowance could be increased to + 0.006 in. and the tolerance to + 0.002 in., making a new dimension of 2.756-2.758 in. It was further agreed that the pipe would be accepted if it came within the limits on a mean diameter.

This information was conveyed to the chief engineer, who refused to alter the drawing. After days of contention, during which the parts were made to the new limits, he was forced to attempt operating the lathe to the limits he had set. Failing in this and also failing to obtain the needed tightness between parts he had made, he grudgingly changed the drawing to agree with the snap gage already in use.

Another extreme case concerns the boring of holes for roller bearings. In this plant, the engineering department controlled the manufacturing limits and decreed 0.0002-0.0004 in. over the nominal outside diameter of the bearing cup. The machine department rightly decided this was unreasonable and bored the holes undersize for a scraped fitting. The inspectors rejected the bearing cases, but the shop refused to change them and the pieces were sent on to the erecting floors. This condition existed for several years until finally corrected during a standardization program. In this instance, all three divisions were at fault.

An example which verifies the benefits to be derived from correct limitations is found in a factory where the allowances and tolerances are first determined jointly by the designing engineer in charge of the particular product involved and the chief tool engineer of the shop personnel. In this manner, the tentative limits of the design are amicably adjusted to meet manufacturing conditions with a view to capabilities and ultimate costs. Sometimes small changes in design are made when economies of machining can be effected.

In this plant, the chief inspector has the authority which should be intrusted to him but which is withheld in so many factories. He is frequently called into consultation while limits are in the formative stage. After the drawings are in the shop and production started, he takes the lead in securing readjustment of dimensions that are causing trouble in machining or assembling. When the corrections have been made, the inspectors see that they are maintained. However, corrections are seldom needed, for the limits meet the three-fold combination of what the engineer requires, what the shop can produce, and what the inspector can maintain.

The proper setting of limits is predicated upon the laying aside of personal prejudice, a true evaluation of small decimal quantities and complete coordination between the departments interested in design and production. When these factors are present in a factory, the limitation of limits to a commonsense basis will follow and help achieve the aim of thinking factory executives: a better product at a lower price.

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The inspector acts as an arbitrator between the drafting room and the shop

Weights, Rates, and Costs by Chart—*Discussion*

CONRAD GREEN

Are we drifting into too much red tape, useless tabulation and complex mathematical theory, understandable by few and of slight practical use in any case?

I am led to make the above remark by reading Paul R. Fechheimer's article (*AM* — Vol. 76, page 733). While fully conceding the keen mathematical analysis in this discussion, it seems to me that it is entirely too ponderous a method for obtaining a result that can be derived with accuracy by an exceedingly simple arithmetical computation. The problem can be quickly solved as follows and no pre-prepared tables or calculations are necessary.

If, as stated, the cutting speed of the planer is 34 ft. per min., and the return speed is 60 ft. per min., obviously the time required to cut 34 ft. is one minute and the return time is 34-60 of a minute. That is, in 1 34/60 min. the cut of 34 ft. can be taken and the platen returned to starting position for another cut. The whole cycle of cut and return is therefore, 94/60 min. As it requires 94/60 min. to make a cut 34 ft. long, a cut 21.7 feet long can be taken in one minute. 34 multiplied by 60 and divided by 94 equals 21.7. This result is nearly correct and somewhat more accurate than the result given by Mr. Fechheimer.

The distance planed in one minute is given instead of the average speed of cut which is not as important. It can be obtained by multiplying by 2.

No one is justified in these strenuous times in making use of cumbersome methods in the drawing room, machine shop or foundry. Direct methods should be used wherever possible. No time should be wasted in preparing tabular information or charts unless real use can be made of the information so worked up. The mental exertion required for such work should be directed and kept in useful channels. Myriads of problems are coming up that will test the powers of inventors, designers and draftsmen to the limit.

There is one glaring fault in many drawing rooms that I have visited: Many are without sufficient mechanical and engineering information for the use of the draftsmen. For efficient work, every designer and draftsman should have instantly available the usual handbooks, treatises on machine design, kinematics, mechanics and strength of materials. He should be a faithful reader of the leading mechanical journals as well as one or more of the commercial journals covering metal-working and general engineering.

Circuit Breaker Production

C. M. RICHARDSON

Mansfield Works,
Westinghouse Electric & Manufacturing Company

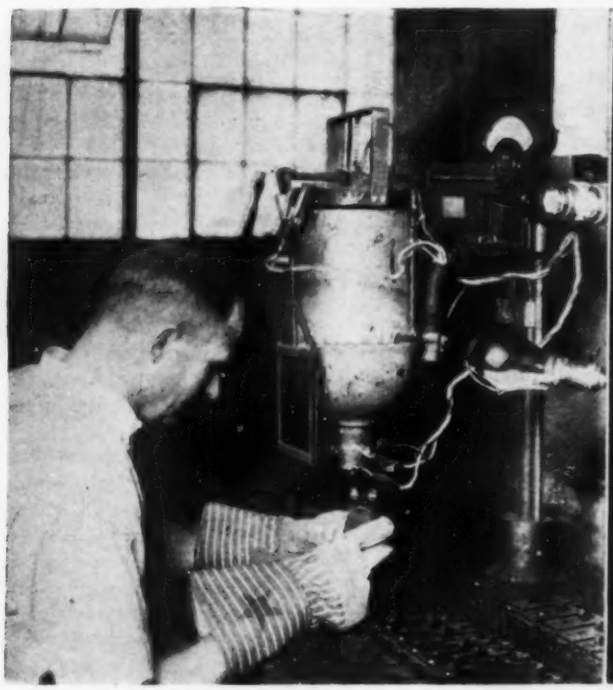
PRODUCTION of the smaller "De-Ion" circuit breakers has been so planned at the Mansfield Works that the manufacture of these breakers resembles the assembly line of any staple product. Tools and other mechanical equipment have been standardized so that various sizes of circuit breakers may be assembled on the same line without any noticeable change in equipment or personnel. They are ninety-seven styles of these circuit breakers in popular use in the home and in industry at the present, which represent an expenditure of more than half a million dollars for development by Westinghouse.

The first operation in the actual production of the circuit breakers is the blanking and heat-treating of the bimetal strips, the heart of the circuit breaker. The word bimetal means, as signified, two metals with different coefficients of expansion welded together. Heat causes them to bend and by so doing provides mechanical action that releases various latches and contacts that are capable of breaking currents as high as 10,000 amperes. The heat is not produced to this degree unless there is dangerous overloading in the conductors the breakers protect.

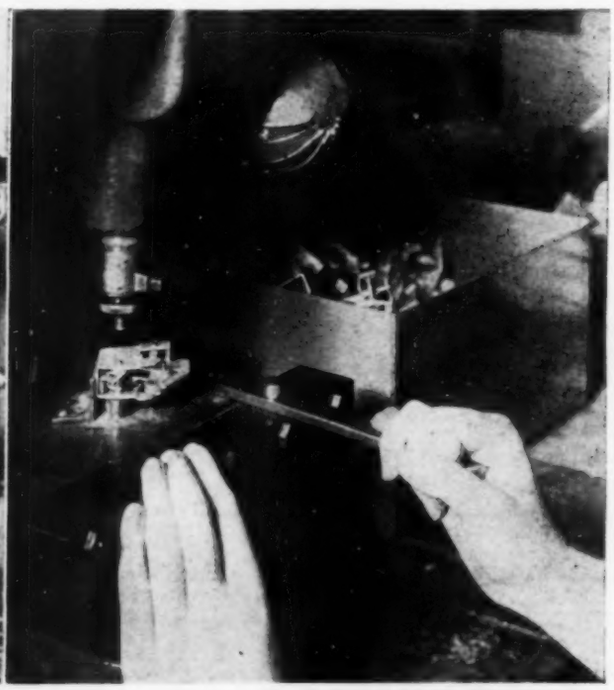
After the heat-treating process, subassemblies are made and turned over to the inspectors who give the material visual inspections and check the bimetal units for resistance and voltage to ground. Before actual placement in the breaker, all the bimetals go through the same operation, whether assembled into the smallest or largest breakers.

The assembling of contacts, which will not weld together under any current, to the terminals, drilling, tapping and assembling screws, are the next operations in the production of the breakers. These contacts were a unique development and meant much towards the successful design of a low-priced air circuit breaker. The assembly of the flexible shunt, which consists of hundreds of small wires, each of which is plated, and the sorting and assembling of the material as to mechanisms are the next processes in order.

After the mechanism is assembled with the handle, it is again given visual inspection to see that it is assembled ac-



A high-speed automatic wax pot is used to seal operating parts to prevent tampering



One of the breaker toggle non-rusting bearing pins being spun in place during assembly

cording to specifications, and if there are no defects in workmanship or materials, the mechanism is ready to be mounted on the composition breaker base.

The final assembling of the breaker is divided into several operations. First, the terminal and contact, arc plates and bimetal mechanism are put together. The arc plates are a distinct Westinghouse feature and therein lies the name "De-Ion." These arc plates deionize the arc, break it into small segments and destroy it. The breaker is then given its final adjustment, and the inspection department tests it for visual and mechanical defects and voltage to ground.

From the inspection bench the breakers are placed in trucks that convey them to the constant temperature room. There they are left for two hours before they are calibrated. This period of time is allowed for the purpose of being sure that the material and metal parts are down to a specified temperature before calibrating. Over a period of time it has been proved that calibrating in a constant temperature permits much more accurate results. In calibrating, the breakers are set by means of a spring balance to trip off at a specified time at 150 per cent overload. Equipment for this is of the latest design, using a regulated line of 110 volts that never varies more than plus or minus one volt. Watt-hour meters are used to determine tripping time, thus eliminating the human element in checking time with a stop watch. After calibration, the covers are assembled and the breaker is then sealed with sealing compound.

Samples from each lot of breakers are given life tests to determine that each lot is up to the Underwriters' standard before shipping any to stock. Periodically a representative from the Underwriters' laboratories runs tests.

During the final inspection, all breakers are gaged for correct height and width. Particular attention is paid to mechanical operation and physical appearance of breakers. Sealing compounds must be poured at one temperature, not to exceed 550 deg. F.

Finally, each breaker is stamped with an inspection stamp previous to being packed for stock or shipment. Unusually close attention is paid to packing to assure the manufacturer that it is sufficient to withstand storage shock and wear, and at the same time protect the breaker. The rigid inspection to which these circuit breakers is subjected has resulted in exceptionally trouble-free service, as indicated by the fact that not one breaker has been reported as failing electrically.

The sole duty of two of the girls at this bench is to inspect and to give all screws a final tightening

Breaker toggles are assembled on this group of machines

Saving High-Speed Steel
Discussion

BERTIL FALCK
Mechanical Engineer
Star Electric Motor Company

The initial saving of steel in grinding a toolbit by the method described by Edward Lay in an article under the title given above (*AM*—Vol. 76, page 1104), becomes a source of waste when regrinding the tool. The proper way to regrind a toolbit of this kind is to grind on the sides, which would result in grinding off the tip completely. It is then necessary to grind a new 60-deg. included angle. I will not attempt to calculate the amount of steel wasted in this way, because it depends upon the person doing the grinding.

Pressure exerted on the tool in cutting standard forms of thread is chiefly perpendicular to the work axis. This makes it preferable to mount the toolbit in the direction of the force applied to it, which can not be done with a tool ground in the way recommended by Mr. Lay. I am still a believer in the old way of grinding a toolbit for threading, though it would be better still to buy toolbits already ground to the correct angle. Such tools can be bought complete with holders for a few dollars.

Contour Calculations for Forming Tools—X

A universal grinding machine, of which that illustrated is typical, is needed to grind forming tools, both contour and rake

O. A. JOHNSON

Chief Tool Designer
Tyson Roller Bearing Corporation

Grinding and mounting are important if the accuracies of tool design are to be maintained in the shop

IN THE preceding articles of this series, the necessity for grinding a top rake angle on the forming tool when forming steel parts has been pointed out. This angle should be determined before the contour of the tool is calculated, and the rake should be ground to this predetermined angle.

The rake angle should be gashed in the shaper or milling machine after the tool has been turned in the lathe. Enough metal should be removed to give ample chip room (see Fig. 74). This design is also desirable to make the cutting edge accessible for checking the setting height of the tool and to charge the oil stream at the most effective angle, which is essential to obtain the best results.

Some toolmakers prefer to gash the tool after it has been hardened. This method cannot be recommended as a considerable amount of stock should be removed, which is done more easily before hardening, and no difficulty is encountered in grinding the contour of a tool that has been gashed before hardening.

One way of checking the rake angle of a forming tool, which has been ground parallel to the center line of the tool, is shown in Fig. 75. The rake should be even with the scale when holding it tangent to the boss. The diameter of this boss is the diameter of the tool at the point that has been calculated to cut on center of the work times the sine of the included rake angle (the periphery clearance angle plus the rake angle). If it is impossible to make a boss on the end of the tool, a counterbore or narrow groove will answer the same purpose.

How to grind the rake angle on a tool having a rake at an angle with the center line of the tool, is shown in Figs. 76, 77 and 78 in sequence. We will assume that the tool is ground in a No. 13 Brown and Sharpe universal grinding machine. With the tool on the same arbor used for grinding the contour, hold the arbor in the vise as shown in Fig. 76. First touch the side of the arbor with the grinding wheel and get the reading of the handwheel. Adjust the grinding wheel towards the cutting edge of the tool one half the arbor diameter minus the grinding stock. Then turn the arbor in the vise until the point of the tool that was calculated to cut on center of the work touches the grinding wheel. Grind off of the point of the tool the amount that was allowed for grinding stock and blue the small area that has been ground. Tilt the vise the included rake angle (the periphery clearance angle plus the rake angle). See Fig. 77.

Then swing the table of the grinding machine (Fig. 78). The angle to swing the table was called the vise angle in the preceding articles when showing how to calculate forming tools having a rake angle ground at an angle with the center line of the tool. Now the tool is ready for grinding and should be ground until the blue at the point of the cutting edge disappears. This is an accurate way of grinding the rake angle for this type of a tool with standard equipment.

If trouble is experienced in getting the proper angles and diameters on the product, this trouble cannot be corrected by grinding the rake at a different angle, as by doing this, we may possibly get

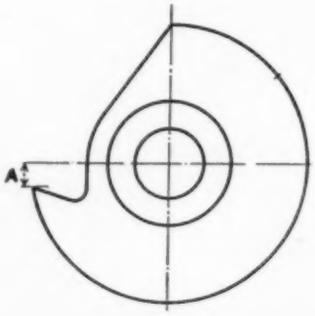


Fig. 74—For accurate results the setting height *A* must be identical to that calculated for the tool

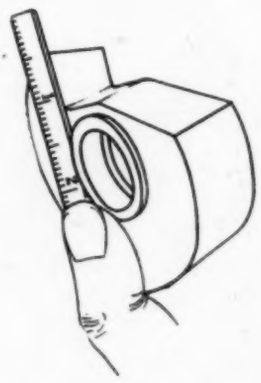


Fig. 75—When the tool is gashed parallel with the center line, the rake angle may be checked from a boss or a groove turned when the profile is machined

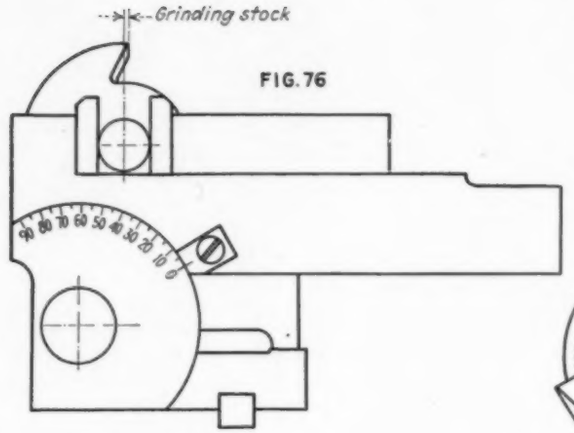


FIG. 76

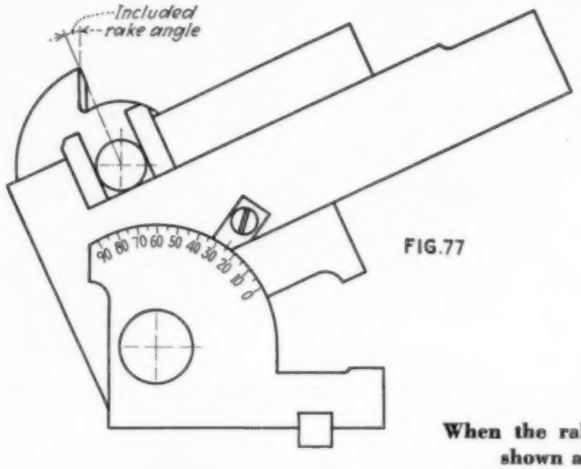


FIG. 77

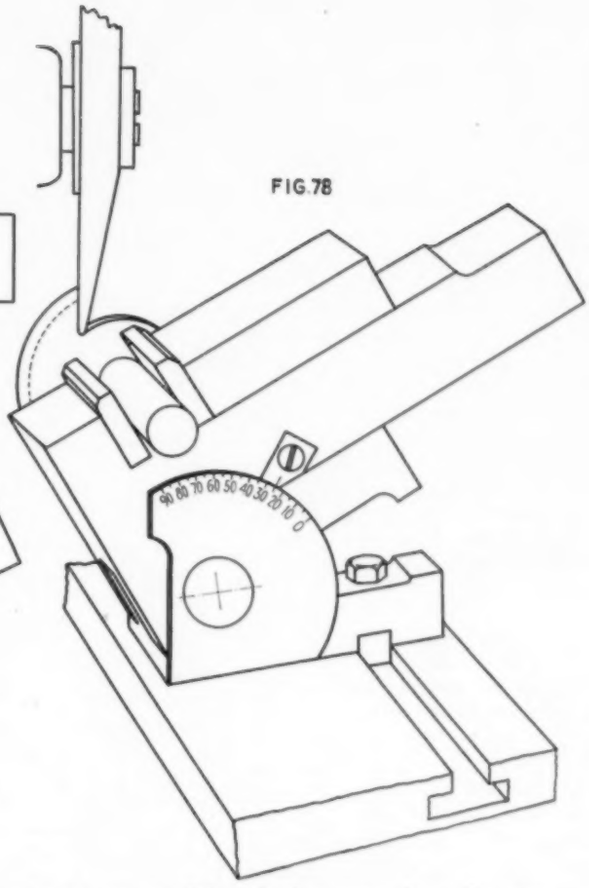
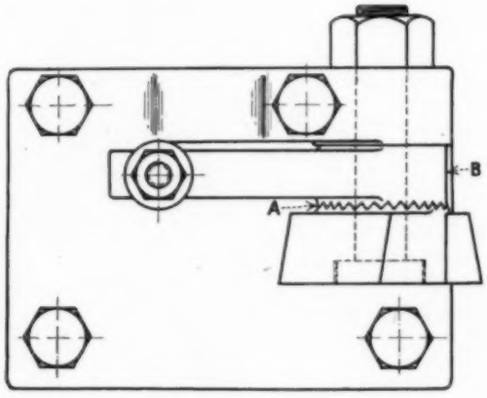


FIG. 78

When the rake is not parallel with the center line, the steps shown above are followed to obtain the correct angle



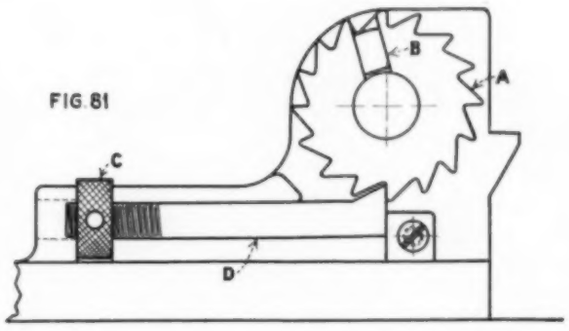


FIG. 81

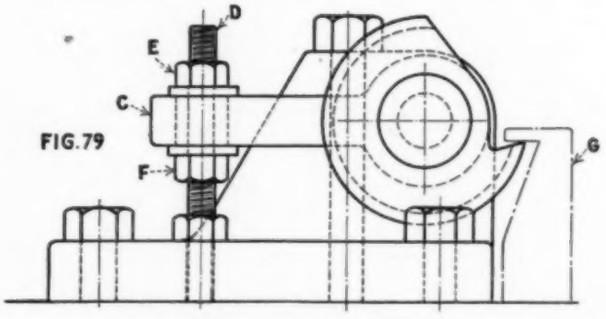


FIG. 79

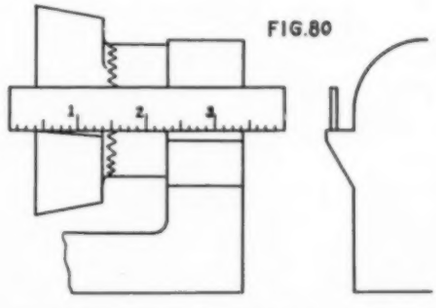


FIG. 80

Figs. 79 and 80—Either a gage or a straight edge may be used to set the cutting edge to the center of the work. Fig. 81—An alternate method of supporting the forming tool permits adjustment without loss of precision

two diameters and one angle correct on the product, but the rest of the profile will be wrong.

First, it should be determined whether the tool is right. If the profile diamensions are within a tolerance of plus or minus 0.0002 in. and the diameters within plus or minus 0.005 in., the tool should cause no trouble. It is, however, necessary that the setting height of the tool, Fig. 74 *A*, be exactly the same as used when calculating the tool. The setting of the cutting edge exactly on center of the work is greatly facilitated by making a gage as shown in Fig. 79 *G*. Another method is shown in Fig. 80 and consists of laying a straight edge along a protruding lug on the tool-holder and adjusting the tool to this edge.

If these different precautions are observed and the tool is set at the correct angle, no difficulty should be experienced in turning out an O.K. piece at the first set-up.

Forming Tool Holders

The method of securing the tool to the holder is also an important factor. It has been stated before that the contour of a calculated forming tool should be ground, and therefore it is also desirable to grind the bore. In Fig. 79 is shown a method of securing the tool to the holder and also of providing for adjustment of the tool after sharpening the cutting edge. The end of the tool is provided with a boss *A*, having V-shaped clutch grooves. Between the tool and the holder is part *B* having corresponding grooves and an arm *C* provided with an elongated slot for the adjustment screw *D* which is secured to the base of the toolholder.

When adjustment of the cutting edge is necessary after sharpening the tool, this is done by turning the nuts *E* and *F*. This method of holding the tool is satisfactory when accuracy is not demanded. If, however, the work must be held within close tolerances, this method cannot be recommended because the clutch teeth on the tool have been milled before the tool was hardened and therefore, either because of hardening distortions or the difficulty of grinding the bore or the contour true to these teeth, the tool will assume a different position as it is adjusted after the cutting edge of the tool has been sharpened. This trouble may be corrected by moving part *B* to the opposite end of the tool. This is objectionable when tools of great difference in length are used on the same holder and also because it is desirable to have the tool as close as possible to the spindle nose of the machine.

A method that has proved to be accurate is shown in Fig. 81. Part *A* is provided with ratchet teeth around the circumference. This part is ground on both sides and a key *B* is pressed in on one side. This key fits in a keyway on the tool (see Fig. 56, Article IX). The tool is adjusted by turning the nut *C* on pawl *D*. The end of the tool is ground square with the bore, and because the contour of the tool is ground true with the bore, this method will assure the greatest precision.

Allowances for Growth of Nitriding Steel

RICHARD TULL,
Electro Metallurgical Company

In many industries there is a growing demand for nitrided steel parts having great hardness and abrasion resistance. A number of nitriding steels are available, and the several methods of developing an extremely hard, wear-resistant case, make it possible for the designer to specify a steel that will exactly meet his requirements. On some types of work extreme hardness of the case may be the only requisite, while for other applications a steel core of considerable strength and toughness coupled with a moderately hard case may be desired.

One of the newer nitriding steels contains substantial amounts of chromium and vanadium and possesses characteristics similar to the S.A.E. 6100 series of steels. By slightly varying the composition and heat-treatment of the chrome-vanadium nitriding steels, it is possible to obtain almost any desired strength and toughness of the core metal. At the same time, the depth of case may be controlled by using either the ammonia or the duplex-cyanide process as well as by varying the length of time for the nitriding process.

A question frequently raised both by engineers and machine shop men, who are not entirely familiar with nitriding steels, is the allowance for final grinding after nitriding. Generally no allowance is made for grinding after nitriding of either the chrome-aluminum or chrome-vanadium nitriding steels. However, after the nitriding operation it is usually found that there has been a slight change in dimensions caused by an increase in volume of the nitrided case due to the absorption of nitrogen. Usually there is an increase in the diameter of 0.001 to 0.002 in. which, of course, can be allowed for in finishing the article prior to nitriding. These figures cannot be accepted as applying to all cases, since the shape of the piece, the length of time of nitriding, and fabrication practices may necessitate a larger or smaller figure. For complicated pieces it has frequently been found desirable first to estimate the necessary allowance and then to determine it accurately by making a few trial pieces.

The steels are seldom ground after nitriding, but are usually lapped to the exact size required. This practice has been found entirely satisfactory for the majority of applications.

Allowance for distortion is not necessary in a nitrided steel provided suitable care is given the steel before the case is developed. All machining strains must be completely relieved, and the heat-treatment given the material, in order to develop the desired core properties prior to nitriding, must be properly carried out. When nitriding is done by the ammonia process, there should be no distortion of the chrome-vanadium nitriding steel because the temperature employed, approximately 460 deg. C. (860 deg. F.), is well below the critical temperature of the steel.

Questions such as these are frequently raised as new applications for nitriding steels are developed. With the introduction of better nitriding steels and through the refinement of nitriding processes, many problems which were frequently stumbling blocks have been solved, with the result that nitriding steels are finding increasing use.

Chromium Plating Cast Iron

W. E. SPLAIN
Mechanical Engineer

We made a temporary set of cast-iron rolls for rolling rather intricate shapes from 20-gage mild steel. Since the rolls stood up very well, we decided to have them plated with chromium to render them permanent. After they were plated, the rolls were put in service and an eight-hour run failed to develop any noticeable wear. The rolls were not used again for about a month and when they were again put in service they were completely ruined within ten minutes. The chromium plating cracked off in places, exposing a deeply pitted surface having the appearance of defective cast iron with sand spots and many small blow holes.

After a thorough investigation we found that the plater who did the work had, either through accident or ignorance, deposited the chromium on the cast iron without preplating it with some other metal from a neutral solution. The cast iron being porous had absorbed some of the acid in the plating solution. The hard chromium case deposited on the iron had trapped the acid in the pores and the acid had gradually disintegrated the iron, so that in a short time there was no solid backing left for the chromium case and the rolls were ruined.

Contributory Infringement

H. A. TOULMIN, JR.
Patent Attorney

CONTRIBUTORY infringement of patents is usually inadvertent—by reason of a manufacturer's ignorance of ramifications of the patent law as worked out by the courts during a century and a half. It is one of the most costly misfortunes that can happen in manufacturing. Every engineering department is facing this problem to an increasing degree because of the trend toward furnishing subassemblies or semi-fabricated parts that are later incorporated by others into a complete piece of equipment.

Thus, in a stoker and boiler installation, one manufacturer furnishes a motor, another a valve, another a boiler, another a stoker and still another a thermostatic control. But—and it may be an expensive "but"—each one of those manufacturers is responsible as a contributory infringer if any single element of the combination completes an infringing combination. It is important to know, therefore, not only that your own patent is valid, but that any combination in which it is to be used does not infringe any patent.

If a manufacturer provides even a single unpatented part of a combination which infringes a patent and if it is shown that the part he furnishes would not have any commercial use except as a part of the combination, he is guilty of contributory infringement, just as though he made the entire combination.

A Costly Error

A large electrical manufacturer once made this costly error, doubtless through ignorance. The case had to do with a system of power transmission patented by another manufacturer. The electrical manufacturer furnished a power company with a special motor that could only be used in the practice of the patented method of transmitting power. The Court said that such manufacturer was therefore equally guilty with the power house in practicing the patented method of transmitting electrical power and was a contributory infringer.

The United States patent did not extend to Canada. The motor would have to be intentionally used in the United States with the infringing combination in order to be contributory infringement of the United States patent. The making of the motor in the United States alone did not constitute a violation of the rights of the patentee in this country.

Now let us consider a quite common situation where a manufacturer turns out a special machine that in itself does not infringe any patent, but which can only be used as a means of carrying out a patented process. Will the manufacturer of that machine be held to be an infringer of the patent on the process?

Such a case arose in New York regarding a patent on a process of manufacturing cigars where a manufacturer of cigar making machines, with knowledge of the process patent, supplied cigar-making machines designed to perform some of the steps in the process. It was held that to supply a machine with the intent that it should be used as a part of the process was contributory infringement.

Generally speaking, a manufacturer who makes and sells an apparatus adapted and intended for no other use than that described in a certain patent, whether it be a mechanical patent or a process patent, is a contributory infringer and is equally liable with the ultimate user.

A variation of this rule occurred in connection with a filter. The plaintiff owned a patent on a filter used for filtering chemicals. The filter consisted of a casing, various kinds of mechanical apparatus and a filtering material. The defendant had been supplying the user of the filter with the filtering material with full knowledge that it was going to be used in the patented filters. Even though the filtering material was itself unpatented, and could not be patented, but was only a part of the patented combination and used in the practice of a patented process, to furnish it was held to be contributory infringement.

Contributory infringement is perhaps most often committed by making or selling *part* of a patented invention with the intent that it shall be assembled with other parts that will constitute an infringing combination. But it may also be committed by making and selling a machine particularly designed to have incorporated in it a patented device. This is true even though the patented device be placed on the machine by another. However, if the machine so supplied is adapted to other than the infringing use, the maker is not liable if another places it in an infringing combination.

Such a case arose where the defendant manufactured a price calculating attachment for scales, which did not necessarily have to be used on the patented scale in question. This attachment was an article of general commerce and had been sold generally for use on various types of scales, patented or not.

A user of a non-infringing scale placed this attachment on his scale and thereby made it an infringing scale. Suit was brought by the patentee against the manufacturer of the attachment. The Court decided that since the attachment was one of general commerce there was no provable intention of supplying it for the purpose of making up the combination, and that there was no contributory infringement.

Confusing Ramifications

The question often comes up as to when an owner of a patent can hold for contributory infringement one who supplies materials that are used in the patented combination, such as paper, ink, stencils, wire, or any other similar class of supplies. This opens the door to ramifications in contributory infringement rules which often are confusing.

A good illustration is that of a patented bottle capping machine for supplying a special form of bottle seal or cork. The patented machine was only sold on condition that the unpatented seals or corks be purchased from the owner of the patent on the machine.

The defendants supplied these unpatented corks and seals to users of the patented machines. It was held that this was contributory infringement of the plaintiff's patents even though the patents did not cover the unpatented form of seal or cork. The machines had been licensed or sold by the patentee and were legitimate machines having their origin in the plant of the plaintiff, but nevertheless the patentee could control the use of the unpatented corks on these machines because they were a part of the patented combination.

It is well to bear in mind always the legal definition of contributory infringement which is:

"The intentional aiding of one person by another in the unlawful making or selling or *using* of a patented invention."

That is a fairly good guide. But there are ramifications and subtle distinctions which are apt to be pitfalls. The safe thing to do when in doubt is to get competent advice.

Courtesy Worthington Pump & Machinery Corporation *Photo by Rittase*

Hands guide and chips fly—

another job well done

EDITORIALS

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EDITORS

Technocracy

Ever since the mystic word "Technocracy" caught the fancy of newspaper editors and was spread in the headlines, engineers and economists, business men and laymen, chambers of commerce and economic forums have been trying to find out what it is all about. The spokesmen for the group which calls itself technocracy have been disturbingly vague, intentionally or otherwise, and their cause has not been helped by the publication in general magazines of unauthorized articles containing conclusions that are hardly justified by what facts have been released, and that have been repudiated by the organization.

We believe that technocracy has received far more attention than it really deserves, and that in normal times its spokesmen would have had hard work winning an audience. With everybody's nerves on edge, by reason of three years of tension, the shock value of the portentous calamities hinted at by technocracy has been multiplied. Hence the interest.

The facts on which technocracy bases its charts and from which its philosophical speculation starts are known to economists, business men and engineers who have paid any attention to government statistics. The conclusions or inferences drawn from these facts, some of which have been disturbing, seem to us to be highly speculative. But, after all, Americans are born speculators and now that they have little left for financial speculation why should they not turn their attention to economic and philosophic speculation? Provided always, that they speculate somewhat more intelligently than they did in Wall Street. We feel that speculative urge and we propose, therefore, to do a bit of speculating of our own in the next issue of *American Machinist*.

Another Palliative Proposed

Under the heading "New Jobs for Old," an editorial in the *Washington (D. C.) Post* described a plan said to have been adopted by a manufacturing concern. A ruling has been set up in this company whereby no man may be displaced by a machine until other work has been found for him within the organization.

It is claimed that this restriction has spurred the research department to the development of new products that have been instrumental in increasing company profits. It is suggested that a widespread adoption of similar plans would be desirable.

Despite the superficial pleasing possibilities of this scheme, a closer examination shows it to be another of the many plausible but impractical palliatives that have been advanced in the past two years. Perhaps one company did benefit by this action. But the danger of establishing a broad conclusion from this isolated instance is apparent.

More power to the concern that spends money widely in research. Greater diversification may or may not be advisable as the result. But whether a company is aggressive or conservative in its development policies, whether it is broadening its output or concentrating on established lines, there is no logic in arbitrarily linking these activities with those of plant modernization.

Even as a means of maintaining employment the scheme falls down. A new development may not be ready for production when the need of modern equipment is vital for current work. Delay in the acquisition of this equipment may mean higher costs, loss of orders, and lower employment in the plant postponing action and in the plants of equipment suppliers. The problem of new products and readjustment of labor is too large to permit of solution within the four walls of one plant.

By all means let us be awake to opportunities in new products. But let us keep our business judgment free from needless self-imposed restrictions that impede the freedom of action so essential in these times.

Mid-Winter Freshmen

What to do with the boys and younger men from seventeen to twenty-five is at least as serious a problem as any that has arisen in the last three years. Some of the boys graduated from the high schools, technical schools and colleges have been able to take post-graduate work, but the majority have been stranded because industry has no place for them.

To complicate the problem still more, the city high schools are graduating thousands of boys in midwinter, at the end of the first term. Heretofore, those boys have been able to pick up odd jobs that would keep them occupied until the following September, if they were expecting to go to college. This year there has been no such opportunity.

Dr. Harvey N. Davis, president of Stevens Institute of Technology, has announced a plan to take care of a few of the best of these boys, a plan that merits the highest commendation. He proposes to start a new freshman class in February, made up of hand-picked applicants, with the idea that the bright ones will catch up the regular freshman class and be graduated

in three and one-half years, while the plodders will drop back a class and finish in four and one-half years. Rutgers University has announced a similar plan.

Each school has the requisite facilities, and what comes of the experiment will be worth watching.

Standards of Finish

Dimensional tolerances can be easily specified and inspected but it is a far different matter to specify the kind of finish desired for the surface of the work. Yet the quality of the surface may affect the usefulness of the piece almost as much as the actual dimension. This is one of the reasons for the interest shown at the initial meeting of a committee to formulate standards for surfaces of various kinds as well as methods for measurements and comparisons. Representatives of many industries are interested in having some standard by which to designate, and to secure, the desired finish on surfaces of various kinds.

The committee faces a task that will require not only patience and ingenuity but also much research into methods of comparison with desirable standards. For while any sort of inspection may be termed measurement, and the kind of surface can perhaps be determined by measuring its irregularities, these measurements have nothing to do with dimensions that affect fit as determined by gages.

Standards of finish are highly desirable and the committee should therefore have complete cooperation from all sides. The work they have undertaken will have widespread application. If successful, it will not only prevent costly misunderstandings between supplier and user, but will also increase our knowledge of the kind of finish best adapted for various purposes.

• CHIPS •

England pays the December installment on the War Debt . . . as every intelligent American fully expected she would . . . Italy, Latvia, Czechoslovakia, Finland and Lithuania do likewise . . . Way is thus cleared for revision negotiations that are sure to follow . . . France, better able to pay than any of the other debtors, defaults despite heroic efforts of Herriot . . . proves she has an even more difficult legislative body than we have . . . Belgium, Estonia, Poland and Hungary also fail to pay . . . House committee reports beer bill . . . hopes to forestall sales tax . . . Senate working on modified repeal resolution . . . agrees to vote on Glass banking measure early in January . . . House cuts treasury-postoffice appropriation bill and approves it . . . Administration plan for combining departments faces objections in Congress.

Automobile companies recall men to build new models . . . Hudson recalls 4,200; Cadillac 3,250; Willys-Overland 3,000; Fisher Body 4,000; Hupp 1,100; Continental an unannounced number . . . Work sharing extended to marine unit of Standard Oil of New Jersey . . . Quaker Oats plant goes on full time . . . Weidman Lumber Co. mills in Michigan go on overtime . . . Continental announces low-priced car distribution direct-to-buyer . . . 4-day drive in New Brunswick, N. J., brings work estimated at 50,000 hours.

Treasury 1-year issue at 0.75 per cent oversubscribed sixteen times . . . 4-year, 2¾ per cent notes oversubscribed twenty times . . . cash reserves in banks are evidently heavy . . . R.F.C. offers terms to finance six million bushels of wheat for China . . . lending power of corporation extended a year by presidential proclamation . . . Rapid payment of bills started by Wall Street firm to speed turnover and stimulate trade.

Russia and China resume diplomatic relations . . . Japan greatly exercised thereby . . . French cabinet falls on debt payment issue . . . Senator Borah, in interview, advocates U. S. recognition of Soviet government . . . Belgian cabinet resigns after voting debt default . . . Five powers sign disarmament formula that seems to assure continuance of effort to arrive at a satisfactory treaty . . . Japan asks 11–11–8 ratio for all classes of war vessels . . . Amtorg chairman predicts Soviet expenditures for equipment under second 5-year plan will be double those of first plan.

Railroad executives and labor leaders offer and refuse various plans for railroad wage adjustments . . . I.C.C. authorizes P.R.R. to use cab signals instead of automatic train control on seashore divisions . . . Atchison board authorizes purchase of 26,000 tons of rails . . . National Advisory Committee for Aeronautics finds dirigibles best suited for trans-oceanic flying . . . Shipping Board orders 40 more old ships scrapped.

National Coal Association discusses plans for independent bituminous research laboratory . . . Steel production recedes to 15 per cent . . . prices steady except scrap which declines . . . Electric output up from previous week but still 9 per cent below 1931.

Rehabilitation Projects Exceed $105,000,000

According to a statement made by A. W. Robinson, chairman of the National Committee on Industrial Rehabilitation, programs involving the expenditure of $105,266,429 by industrial plants and retail establishments are under way or will begin soon after the first of the year. This report includes commitments decided upon after visits by committee representatives and those adopted without contact by the committee.

District 1—$387,300; District 2—$62,500,000; District 4—$8,041,000; District 5—$220,000; District 6—$5,590,000; District 7—$2,439,526; District 8—$8,010,698; District 9—$475,000; District 10—$880,000; District 12—$16,722,905.

Companies in the metal-working industry that have recently reported are:

District 1—M. C. KNIGHT, chairman.
E. T. Burrows Co. Makers of screens are making new capital investment, $150,000.

District 4—E. T. WEIR, vice-chairman.
Allegheny Steel Co.—Complete rehabilitation program, $100,000; Standard Stoker Co.—Purchase of machine tools, $20,000; American Spiral Spring & Mfg. Co.—Spring tools and heating systems, $10,000; Fritz-Moon Tool Co.—New buildings and modernization of equipment, $65,000; Reliance Steel Casting Co.—General modernization work, $10,000; American Rolling Mill Co.—Modernize Butler, Pa., plant, $60,000; Penn. Iron & Steel Co.—General rehabilitation program, $20,000; Pittsburgh Screw & Nut Co.—Screw and bolt machines, $400,000; Hubbard & Co.—General modernization of plant, $200,000; Union Drawn Steel Co.—Rehabilitation program throughout plant, $30,000.

District 6—THEODORE SWANN, chairman.
Wackman Welded Ware Co.—Steel barrel manufacture, $35,000.

District 7—JAMES D. CUNNINGHAM, vice-chairman.
International Harvester Co.—Equipment for the new "baby tractor" and for the motor truck line, $1,100,000; The Link-Belt Co.—Modernization of equipment, $20,000; Burgess-Norton Mfg. Co.—Modernization and purchase of new machinery, $3,650; Stephens-Adamson Co.—New machinery principally, $2,000; Moline Malleable Iron Co.—Purchase of machinery and modernization, $6,375; All Steel Equipment Co.—Purchase of tools, dies and fixtures, $3,500; Western Wheeled Scraper Co.—Miscellaneous rehabilitation, $6,900; Appleton Mfg. Co.—Modernization in general, $2,000; Northwestern Barb Wire Co.—Improvement to plant and equipment, $36,000; Allis-Chalmers Mfg. Co., $203,305; National Enameling & Stamping Co., $10,000.

District 8—A. B. ELIAS, chairman.
Granite City Steel Co.,—Furnaces, machinery, electric power transmissions, $196,500; The Ludlow-Saylor Wire Co.—Plant rehabilitation and new machinery, $40,000; St. Louis Car Co.—Repairs and replacements at plant, $30,000; Stupp Bros. Bridge & Iron Co.—Modernization and improvements, $35,000; Elliott Frog & Switch Co.—Rehabilitation and buildings, $31,000.

District 12—J. A. H. KERR, vice-chairman.
Chrysler Corporation—Tooling Pacific Coast assembly plant, $275,000.

Machine Tool Orders Rise in November

An index of gross orders of 32, reported by the National Machine Tool Builders' Association for November, was sufficiently above the previous month's figure of 27.4 to turn the three months' moving average upward. November orders were higher than any month since June.

The rise runs counter to the usual seasonal trend. Seven companies received a volume of business above 100 per cent, based on the 1922-24 average, as against four in October. The group, reporting business of at least 50 per cent of the base, numbers seventeen compared to fifteen last month. On the other hand, the number of concerns reporting "less than 10 per cent" rose from 29 in October to 40 in November. Detailed figures are at the right.

	Index A	Index B	Index C	Total
Number of reports	25	27	23	75
Bases	$2,594,128	$635,599	$135,112	$3,364,839
Gross orders for month	33.6	25.0	33.8	32.0
Cancellations	0.9	0.4	1.0	0.8
Net orders	32.7	24.6	32.8	31.2
Shipments	31.1	18.2	37.4	28.9
Unfilled orders	36.6	56.9	80.8	42.2
Three-month's average of gross orders	31.6	20.6	32.5	29.6

Base — Average shipments for the years 1922-24.
Index A — Base more than $50,000.
Index B — Base $10,000 to $50,000.
Index C — Base less than $10,000.
Total — The "total" indexes are not averages of A, B and C indexes but are percentages of the totals of the respective items to the total bases of all reports filed each month.

Production to Be Discussed at S.A.E. Annual Meeting

Three addresses on production will be included in an interesting program planned for the annual meeting of the Society of Automotive Engineers to be held at Detroit, January 23-26. "Some Principles of Flexible, Accurate, Low-Cost Tooling" will be given by J. E. PADGETT, Spicer Manufacturing Corporation. K. T. KELLER, Chrysler Corporation, will speak on "Production, a Human Equation." COL. J. L. WALSH, chairman, Michigan District, National Rehabilitation Committee, will deliver "Automotive Aspects of Work of the Committee on Rehabilitation of Industry."

• INDUSTRIAL REVIEW •

Small as machinery orders have been since the first of November they are managing to flatten out for the usual holiday lull. A little Government business in machine tools broke the general monotony, and there was some activity in supplies in several centers. Distributors are looking forward to a break in January.

From Milwaukee comes word that business in repair parts and small units is building up and that inquiries are on the increase. St. Louis says that nothing of interest has developed in the machine tool and shop supplies lines. Chicago finds that there is more activity in small tools and reports the issuing of a few minor machine tool lists.

In Indianapolis the general feeling is a bit better. Smaller shops are expected to lead the way to recovery in that region. Not much in the way of business is stirring in Cincinnati although the active Rehabilitation Committee in that city has secured commitments for general reconditioning amounting to over six millions, the best record for any city in the Fourth District. The Detroit motor car builders are busy on new models and this activity has extended to the contract shops. If the new models "take," some equipment orders will have to be placed in the first quarter of 1933.

There is a rumor in Pittsburgh that one of the larger companies is going to put through an extensive rehabilitation program but the rumor has not been substantiated. A few orders for small machine tools have been placed. Philadelphia reports nothing new. Machinery men in that district are disappointed at the failure of the Rehabilitation Committee there to function. New York has little to say except that some Navy Yard machine tool orders, advertised six months ago, have finally been placed. In Boston they are looking forward to better business in 1933, having concluded that it is about time to close the books on 1932.

Sharpe Heads New England Council

Henry D. Sharpe, president and treasurer of the Brown & Sharpe Manufacturing Co., was recently elected to the presidency of the New England Council for a term of two years beginning January 1. He succeeds Harry C. Knight, president of the Southern New England Telephone Co.

Mr. Sharpe is also vice-president of the Providence Gas Co., president of the Puritan Life Insurance Co., and a director of the New England Telephone and Telegraph Co. He has been actively identified with commercial and industrial associations and recently completed his fourth term as director of the Chamber of Commerce of the United States.

Long a leader in public affairs, Mr. Sharpe was largely instrumental in bringing about this year the establishment of the Government Research Bureau which is attacking the problems of public expenditures and taxation in Providence. He is also Chancellor of Brown University.

Standard Approved for Spur-Gear Tooth Form

The American Standards Association recently approved the 14½ deg. and 20 deg. full-depth involute systems for spur gears as an American standard. It also accepted the American Tentative Standard for the 14½ deg. composite and 20-deg. stub involute systems originally published in 1927 as an American standard. The combined standard, to be published soon, will give the detailed tooth proportions in terms of both the diamentral pitch and the circular pitch for all four designs. In addition tabular matter is given pertaining to the 14½ deg. and 20 deg. full-depth involute systems for obtaining full involute action with pinions having small numbers of teeth.

Metal Working Executives Active in Marketing Conference

Confidence in the efficacy of aggressively selling the right product to build business pervaded the discussions of marketing problems, held at Pittsburgh, December 5-6, under the auspices of the American Management Association. The meeting was held under the direction of C. J. Stillwell, vice-president, The Warner & Swasey Co., and vice-president in charge of the Industrial Marketing Division of the Association. Frederick B. Heitkamp, general sales manager, Cincinnati Milling Machine Co. and Cincinnati Grinders, Inc., stressed the need of instilling the sales force with new enthusiasm by the introduction of new products.

In an address on "Industrial Sales Management for Present Conditions," Mr. Heitkamp said in part, "The spirit which causes men to do better than they believe possible seems to be lacking and needs to be brought back. Probably it isn't so necessary to discard old successful methods as it is to find a new dress for such methods, or to resurrect many of them which have so long been overlooked that they will appear new when brought into light again."

E. D. Shreve, of the General Electric Co., cited the importance of keeping sales contacts alive today because of the new buyers who are gaining in competitive position.

"Pricing Policies During a Depression" was presented by H. S. Beal, manager, Jones & Lamson Machine Co., and president, National Machine Tool Builders' Association. Mr. Beal emphasized the need of a one-price policy but stated that prices must be varied with the current value of the dollar.

Direct reports from sales executives of eight machinery and equipment concerns were included in an address on "The Trend Toward Expansion of Free Service in Industrial Sales" by J. H. Macleod, vice-president, the Hinde & Dauch Paper Co.

Malcolm Muir, president of the McGraw-Hill Publishing Co., in a talk on the national movement for industrial rehabilitation said, "What is true of the general consumer today is true, also, of the industrial executive and the merchant. They, too, are tired of doing without things they can afford. In increasing numbers, they are heeding the call to make sensible expenditures now for rehabilitation and general improvement of their plants and their stores."

"How to Make Industrial Sales Now" was analyzed by H. P. Bailey, president, The Rotor Air Tool Co. Mr. Bailey said, "Our sales presentation must face the fact that the scale of production of our customer is low and hence our net profit summary must reflect accurately the results which will be realized under the actual shop conditions of the customer." An interesting discussion on this topic was made by R. S. Perry, vice-president, the Ingersoll Milling Machine Co., who stated that sales today were made largely to companies bringing out a new product or changing the design of old products. He pointed out that close contacts should be maintained to permit of early quotations on equipment to manufacture these products most economically.

Gherardi Wins Edison Medal

For his contributions to the art of telephone engineering and the development of electrical communication, Bancroft Gherardi, vice-president and chief engineer of the American Telephone & Telegraph Co., was awarded the Edison Medal for 1932 by the American Institute of Electrical Engineers. Mr. Gherardi's entire professional career has been devoted to the art of communication. Coming into this field in 1895, when the telephone art was still young, he played an important part in the development of operating practices, equipment and apparatus which has brought telephone communication to the state of perfection existing today.

Leipzig Trade Fair

During the week of March 5-12, the Leipzig 1933 Trade Fair will be held on regular schedule. Eight thousand exhibits from 32 countries will be shown, and buyers from twice as many lands are expected to attend.

A regrouping and centralization of exhibits will enable visitors to inspect the latest products of the leading countries in the world in a few days. The plan of offering free trips to Leipzig and return based upon a refund proportionate to purchases, which proved so popular last year, will be repeated. The local office of the Fair is 10 East 40th St., New York City.

Export Drop Estimated at 21 Per Cent

According to the annual report issued by the National Foreign Trade Council, world export trade for 1932 will show a decrease of approximately 21 per cent from that in 1931 and of nearly 32 per cent from the peak of international trade in 1929. Based on the figures of forty countries carrying on about three-quarters of the world's trade, this indicates, in common terms of 1913 dollar values, a reduction of world exports from $21,060,000,000 in 1931 to about $16,550,000,000 in 1932.

The point of outstanding interest about this year's trade is that the decrease shown by the United States is no greater, for the first time since the depression began, than the annual average of trade losses throughout the world. Our own decrease in export trade by 21 per cent compares favorably with that of our principal trade rivals, whose losses in export trade during the year, based on figures for the first ten months, are as follows: Great Britain, 20 per cent; France, 24 per cent; Germany, 24 per cent; Canada, 20 per cent; Japan, 24 per cent. The change represents an intensification of depressed conditions in exports abroad rather than in their improvement in this country, as the general world decrease in exports by 10½ per cent in 1931 from 1930 has approximately doubled with the 21 per cent decrease for the present year from 1931, while that of the United States increased by the small margin, during the same period, of from 20 per cent to 21 per cent. The United States has also been steadily cutting down this rate of decrease during the latter months of the year, when it averaged only about 15 per cent less than in the corresponding period of 1931.

The continued decrease in our export trade is not, however, an isolated fact in our national economy. It equals almost exactly the shrinkage in such fundamental indices of our business life as railroad carloadings, which fell off about 20 per cent during the fiscal year, and the volume of production of our factories and mines which likewise decreased 20 per cent in this period. In other words, the sale of American products abroad is still an important factor in the general trade of the United States of the same degree as heretofore. While some industries are selling less abroad of the total of their production than they did before 1930, others are exporting a larger proportion. There has, for instance, been a relative gain both in the amount exported and in the exported proportion of the amount produced in such important specific items as sewing machines, motion picture film, safety razor blades, radio tubes, iron and steel scrap, electric refrigerators and a number of other items of electrical goods.

Generally speaking, although the year's trade losses have been more evenly distributed than in previous years, the most marked decreases in export trade have appeared in those countries which have most energetically attempted to curtail their imports and to redress their trade balances by means of restrictions on exchange. In the thirty countries where such restrictions have been partial or complete the average diminution in exports during the year was approximately 30 per cent as compared with less than 15 per cent in those countries where no such restrictions have been imposed. Our own country has felt the effects of these exchange restrictions severely, because it is in these countries, most of them being producers of raw materials and importers of manufactured products, where the year's contracted trade has most notably affected our exports of manufactured products.

The reason why our manufactured exports have decreased from a proportion of over 70 per cent of our total exports in 1929 to one of less than 60 per cent in 1932 is fundamentally due more to the hampering effect of these official governmental restrictions than to a decrease in the demand for our products or to any change in their acceptability in the world's markets. The most important problem for solution during 1933 is, accordingly, the mitigation of these exchange restrictions by some means which shall restore the merchandise balances of these countries by stimulating their exports to ourselves and to other active markets in the world's trade.

Standardizing Finishes

A new sectional committee has been organized under the procedure of the American Standards Association, on Standardization of Classification and Designation of Surface Qualities, with Lt. Col. C. G. Mettler as temporary chairman. Many industries are represented on the committee. Considerable interest was reflected by the large attendance at the organization session. Five sub-committees will consider the following division of the subject: Standardization of Surfaces Produced by Tools and Abrasives; Standardization of Surfaces Produced by Mold, Die, Roll or other Distortional Method; Coated Surfaces; Symbols for Indicating on Drawings; and Methods of Measuring Finish.

Council Formed to Raise Engineering Standards

To coordinate and promote efforts directed toward higher professional standards, the following seven national engineering bodies have organized the Engineers' Council for Professional Development:

- American Society of Civil Engineers
- American Institute of Mining and Metallurgical Engineers
- American Society of Mechanical Engineers
- American Institute of Electrical Engineers
- American Institute of Chemical Engineers
- Society for the Promotion of Engineering Education
- National Council of State Boards of Engineering Examiners

The newly formed council is embarking on a program of improving means for educational guidance to young men with respect to the engineering profession, the formulation of criteria for colleges of engineering, the determination of a program of professional growth for young engineering graduates and the formulation of methods whereby engineers who have met suitable standards may receive corresponding professional recognition.

•BUSINESS ITEMS•

At the November 31 weekly meeting of the directors of Cadillac Machinery Co., Fisher Bldg., Detroit, Mich., CHARLES E. FRENCH resigned as secretary and treasurer, after ten years in that capacity, and the resignation was accepted at the following week's meeting. C. L. CAMPELL, president and general manager, will announce the new directors and their selection of a secretary and treasurer following the annual meeting in January. The present board of directors consists of J. M. RIORDAN, B. J. RIORDAN, THOMAS REDMOND, GEORGE H. HAWN, C. L. CAMPBELL.

The Bryant Machinery & Engineering Co., Chicago, has appointed the General Machinery Corp., 140 Federal St., Bos-

ton, as exclusive dealer in the Boston territory on Dreses radial drills, Ohio shapers and planers, Boye & Emmes engine lathes, Ohio horizontal boring, drilling and milling machines, Cleerman drills, Kling heavy-duty grinders and Imperial arc welders.

Gould's Pumps, Inc., has acquired the Hydroil Corp., Lebanon, Ind., manufacturer of oil purifying apparatus, according to announcement of NORMAN J. GOULD, president. The Lebanon plant is being discontinued and the business and equipment transferred to the Seneca Falls plant of the Gould company. D. B. CLARK, vice-president of Hydroil, will join the Gould organization, which will continue to manufacture the Hydroil centrifugal purifying machines.

Electrolux, Inc., has acquired the plant of the Magazine Repeating Razor Co., Greenwich, Conn., originally occupied by the Dalton Machine Tool Co. It is planned to employ 200 in the manufacture of electric appliances.

The Holochrome Screw Corp., Bristol, Conn., has started operations in the former plant of the Root Company on Church Street Extension.

The Federal Products Corp., Providence, R. I., has appointed F. A. Brady, Inc., 30 Church St., New York, N. Y., as direct factory representatives in the metropolitan district. The company's branch office has been discontinued.

The Detroit Seamless Steel Tubes Co. has removed its Chicago district sales offices to 1768 First National Bank Bldg. L. R. PHILLIPS is district sales manager.

The brick factory building of the Wood Turret Machine Co., Brazil, Ind., was destroyed recently by fire. The loss was about $55,000.

• PERSONALS •

A. M. SNODGRASS, production manager of the West Lynn, Mass., works of the General Electric Co., has been appointed production manager of the Pittsfield, Mass., plant to succeed C. E. PIPER, resigned.

JOHN W. MACMORRIS, factory manager of Skayef Ball Bearing Co., Hartford, Conn., for nine years, has been named factory manager of the Norma-Hoffmann Bearings Corp., Stamford, Conn. Mr. MacMorris was previously superintendent and factory manager of the Mercer Automobile Co., New Jersey; and for six years was superintendent of the S. W. Card Co., Mansfield, Mass.

RALPH KELLY, formerly southwestern district manager at St. Louis for the Westinghouse Electric & Mfg. Co., has been named central district manager with headquarters at East Pittsburgh.

A. J. LANGHAMMER, is now manufacturing and sales executive with the Amplex Mfg. division of the Chrysler Corp., in Detroit. He was formerly factory manager for Dodge Bros. of Canada.

HERBERT MORLEY, formerly quality manager for The Detroit Gear & Machine Co., is now factory manager of Muskegon, Mich., plant of the Norge Corp.

DONALD B. PATTERSON, general sales manager, Harnischfeger Corp., Milwaukee, has been elected vice-president. He succeeds WALTER HARNISCHFEGER, who was elected president upon the death of his father.

• OBITUARIES •

GEORGE PORTER BALDWIN, vice-president of the General Electric Co. in charge of activities connected with steam railroad electrification, died Dec. 7. In 1897 Mr. Baldwin entered the employ of the Stanley Electric Mfg. Co., which in 1903 was bought by the General Electric Co. He was made manager of the Pittsburgh office of the General Electric Co. in 1910 and of the Atlantic district in 1915. In 1925 he became a vice-president. President Hoover appointed Mr. Baldwin as a member of a group of several leading equipment manufacturers to consider means of making available to the railroads the $300,000,000 credit which the Reconstruction Finance Corporation had offered to lend them.

EARL BEVIS, president of the Shartel & Bevis Machine Co., Franklin, Ohio, died recently at the age of 55.

LOUIS C. COWLES, vice-president and general manager of C. Cowles & Co., makers of automobile hardware, died Dec. 11 at the age of 70.

GEORGE E. DEAN, founder and president of the Union Steel Products Co., died Dec. 2 at the age of 60 at Albion, Mich.

ERNEST GORDON, 75, superintendent of the brass division of the Jarecki Mfg. Co., Erie, Pa., and connected with that concern for the past 53 years, died recently.

ADOLPH HARTMAN, president, American Metal Ware Co., Chicago, Ill., died recently.

RAY P. JOHNSON, 54, president of the Warner Gear Co., Muncie, Ind., and vice-president of the Borg-Warner Corp., died recently. He was associated with his father in the founding of the gear company and long had been associated with the automobile industry.

WILLIAM A. KAHN, machinery designer, Milwaukee, died at the age of 68. Mr. Kahn was recently general foreman of the Davis & Thompson Co., Milwaukee, manufacturer of special machine tools.

EDWIN RUUD, president of the Ruud Mfg. Co., Pittsburgh, maker of water heaters, died Dec. 9.

CHARLES A. SCHIEREN, president of the Chas. A. Schieren Co., belting manufacturer, died Dec. 4. Mr. Schieren was active in the development of multiple-ply belt for generator drives when such drives were being installed by traction companies, and later directed his attention to high-speed balanced belting for modernized group drive.

ALFRED SCHNEIDER, president and treasurer of the Twin City Machine Co., Minneapolis, died recently. He was 68. In 1900 he joined with O. P. BRIGGS in forming the Twin City Machine Co.

TURNER W. SHACKLETT, 84, for many years identified with the metal industry in Erie and northwestern Pennsylvania, died recently. He served as president of the Odin Stove Mfg. Co. for 20 years.

FRED W. STRECKER, at one time works manager for the Greenfield Tap & Die Corp., died Dec. 4. He was 60 years old.

• MEETINGS •

AMERICAN ENGINEERING COUNCIL. Annual meeting. January 15, 1933. Washington Hotel, Washington, D. C. L. W. WALLACE, secretary, 744 Jackson Place, Washington, D. C.

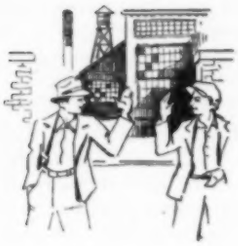
AMERICAN MANAGEMENT ASSOCIATION. Annual meeting of the personnel division. February 7-8. Palmer House, Chicago. JOHN G. GOETZ, managing director, 20 Vesey St., New York, N. Y.

GRAY IRON INSTITUTE. General meeting. January 26. Congress Hotel, Chicago. Gray Iron Institute, Cleveland, Ohio.

NATIONAL ALLIANCE OF ART AND INDUSTRY, Exhibition of new materials, new products and new uses. January 16 to February 15. National Alliance of Art and Industry, 65 East 56th St., New York, N. Y.

SOCIETY OF AUTOMOTIVE ENGINEERS. Annual meeting. January 23-26. Book-Cadillac Hotel, Detroit. JOHN A. C. WARNER, secretary, 29 West 39th St., New York.

THE ROUND TABLE



No Mistakes

"Say, Ed, do you know of a good man who wants a job?"

"Sure, a hundred of them, you ought to know them too."

"I know lots of men who want jobs, but I specified a good one."

"Why do you want another man—business increasing still more?"

"No, to replace the man I have now."

"Well, I don't know of anyone any better."

"He's a good mechanic, and a pretty good fellow personally, but unreliable."

"What did he do—or what didn't he do?"

"He disobeyed orders and nearly got us in bad. I had the expense of a trip to square it."

"That's bad. Somehow it don't seem like Frazer to disobey orders."

"He didn't do it deliberately, but he paid so little attention to what I said that it made no impression on him."

"If you expect to hire a man who never forgets, Al, or to fire one every time he does forget, you better put a permanent ad in the paper. I don't know any such man. What did Frazer forget?"

"I noticed in test that on the big compressors some of the perforated-metal screens had cracks running from one perforation to the next. I was afraid of them after that and substituted special monel wire screens. I told Frazer about it, and when he was assembling this last lot of compressors, I reminded him again. But he went ahead and put in perforated-metal screens."

"And it caused trouble, eh?"

"Yes, we received a telegram saying that one of four compressors was pounding and would not hold pressure. I knew what the trouble was the minute I read it and asked Fraser if he had used the wrong screen. He admitted that he had. Gosh, I was mad. I told him that, if the screen had broken and gone down into the cylinder, he better hunt another job. He was pretty decent about it and offered to go out on the job and not charge any expense money if the trouble was due to a broken screen."

"Why didn't you take him up? It would have been cheaper in the end."

"Yes, but I had an idea that the cylinder and rotor would be pretty badly chewed up. And I wanted to pacify the customer by giving him a new compressor if necessary. That installation is one of our showplaces. I was afraid that Frazer might try to minimize the damage."

"It seems to me, Al, that Frazer has acted pretty white all through. Aside from using the wrong screen, he has the edge on you in the transaction. Excuse me for offering my opinion, but I think it will be a rank injustice to let Frazer go."

"I'm sorry you don't agree with me, Ed, but I am determined to get a reliable man. A big shop has to hire so many men that it must tolerate mistakes. It also has foremen and inspectors to catch and prevent mistakes. In the small shop, a man is foreman, inspector and mechanic combined. The reputation and even the existence of the small shop depends upon the mechanic. I want a man in whose hands my business is safe."

"Is the pay commensurate with the responsibility, Al?"

Is a small shop owner justified in expecting more from an employee than is a corporation? Will Al do Frazer an injustice if he replaces him?

Discussion

Taking Chances

In the absence of a contract, binding all members of a partnership on any new invention that they may develop, each invention should be assigned to the partnership at the time application is made for a patent. These matters certainly should not be left to verbal agreements which are difficult to interpret and to adjust in case of disagreement or death of one of the partners.

The simplest and best way to take care of these matters is to have a general contract drawn which would bind all members on all inventions that would pertain to the company's business. A contract such as this would remove the embarrassment and necessity of one member having to demand assignments from another partner every time an improvement or invention is developed which should belong to the partnership.

—C. F. Staples.

Al violated one of the fundamental rules of common sense when he entered into the existing business relations with Mason. Conceding Mason's honesty and business integrity, nevertheless, situations beyond the control of both parties may arise, which would lead to serious complications.

Suppose a judgment were obtained against Mason, as result of an un-

fortunate automobile accident. Al's property could be confiscated because, legally, all of the property involved belongs to Mason.

Suppose also that Mason were to die unexpectedly. It would put Al in an awkward and embarrassing position to file claim against half of the deceased's patent rights. Suppose further, Al were to die; his heirs would encounter difficulty in collecting equity under Mason's name. —Louis J. Lubin.

Borrowing from the Bank

Al certainly has the right idea. The time to test your credit is when you do not need it. In normal times, if you do not need help from the banks, it would be a good plan to borrow every year or so just to let the banks know you are in business; also it will overcome any awe of the big bankers you would certainly have when you must get credit immediately. Most banks rely more on their personal knowledge of the borrower than a nice statement.

—U. Seth Eberhardt, *Works Manager, Newark Gear Cutting Machine Co.*

Do not borrow money at all. If you are in business, sooner or later it will get your business away from you, and you will have nothing but a bad name and your credit ruined. The secret to successful business is credit, good credit, and the best way to maintain it is to pay your bills. The business cycle is this: Get your order; buy your materials on credit, say thirty or even sixty days. In this time manufacture and deliver the goods, first making sure of your customer's credit standing, and if necessary, give your customer an incentive to pay promptly by a discount; collect the money and pay your bills.

Of course to say all this is easy, much easier than carrying it out, but without exceptional ability, it is being done every day by most of the successful business enterprises. It takes only ordinary intelligence. The profit taken should be accumulated and not squandered; the surplus thus created should be used for undertakings that will require longer time than the ordinary credit will allow to mature into profit. A business thus managed will not find it necessary to resort to banks.

Borrowing is easy, paying back is hard; borrowing has been the death of many a good business man. It is easier to suffer any temporary hardship for the lack of funds than to borrow; for once you borrow, it becomes a habit and only a step to ruin.

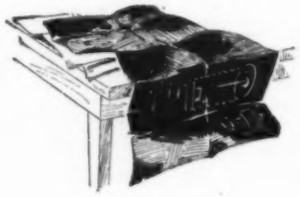
—Frank Browett, *Triangle Tool & Die Company.*

Slightly Worn

For some reason or other, most men starting in the machine tool business feel that they can purchase the cast-off tools of our larger firms or of our failures in like enterprises and succeed in the business that has strewn wrecks all along the line of mechanical progress. Generally speaking, if it were not for the little shops and the shops starting up, the second-hand machinery dealers would lose a lot of business.

For the little fellow to employ labor in competition with the big fellow and expect to pay himself dividends, if he buys second-hand machinery, is almost suicidal. He may get away with it because he is satisfied with less than he could make as a machinist, because he is not compelled to consider from 175 to 250 per cent of cost price in overhead, or because he has a non-competitive product.

Al is right where the writer has been in the past. He started up once in a partnership with second-hand tools and failed for another reason. He has been ready to start up twice since, and has had enough money to start were second-hand machinery purchased, but not enough cash to buy new. Knowing that the man who buys second-hand machinery handicaps himself and starts his



cart towards the official receiver's office or bankruptcy court, the writer will not buy second-hand machinery. He is ready to start up again right now, but the Reconstruction Finance organization is not loaning money to the little fellow —apparently only to political pulling bankers or the railroads.

—C. G. Williams.

Branching Out

It looks to me like a star football player who never participated in any other sport trying his luck at horseshoe pitching. Those things are tried and sometimes prove a success.

Diversification in the small plant should be attempted only after the management has given existing conditions logical consideration. Items such as machinery and tools must be up to the standard in order to contend successfully with competitors. Production of both lines must be uniformly carried on without hindering either item. When capital is lacking, enlarging the plant is out of the question, thus raising the following questions: Can the demand be met with by using two shifts without impairing the equipment which would result in serious breakdowns? Can component parts of the product be purchased outside reasonably? Are the merits of the new line superior enough to those on the market to warrant their manufacture? —Peter L. Budwitz.

Shifting the Burden

W. D. Plumb hit the proverbial nail on the head, with his comments relative to "cut-throat price competition," overselling and "high-pressuring" the retail merchant.

The average merchant is not strong enough financially to carry a large inventory and should not be asked to do so by the manufacturer. It is of vital importance to the manufacturer that each merchant should maintain at all times a strong financial position.

One of the great troubles with business today is the fact that a good many manufacturers—not all—believing there is no place in the present market for high grade merchandise, are marketing inferior products. They are deluding themselves with the idea that a small margin of profit and a large volume of business is the proper way to meet present conditions. As Mr. Plumb so excellently points out, the volume of business is not there.

There is always the hazard, when the margin of profit is small, that if the overhead is not distributed equitably among lines of product, the unit cost of manufacture on some lines may exceed the sale price.

In normal times, it is to a manufacturer's advantage to have less plant than he requires. Too much plant in a normal period is certainly poor management. However, the present time is not a good time to sell excess plant profitably, and if a manufacturer is satisfied to write off his excess plant and equipment as a loss, as Mr. Plumb advocates, why charge the investment in the overhead?

The real remedy for excess plant conditions today is for the manufacturer to purchase raw material at today's favorable prices, operate his plant as much as his reserve finances will allow and utilize his excess plant as warehouse space for raw material and finished products. I do not advocate carrying a large stock of finished products, but it is reasonable to assume that when business regains normalcy, the manufacturer of staples who can give the most favorable delivery will get the business. —Ira S. Williams.

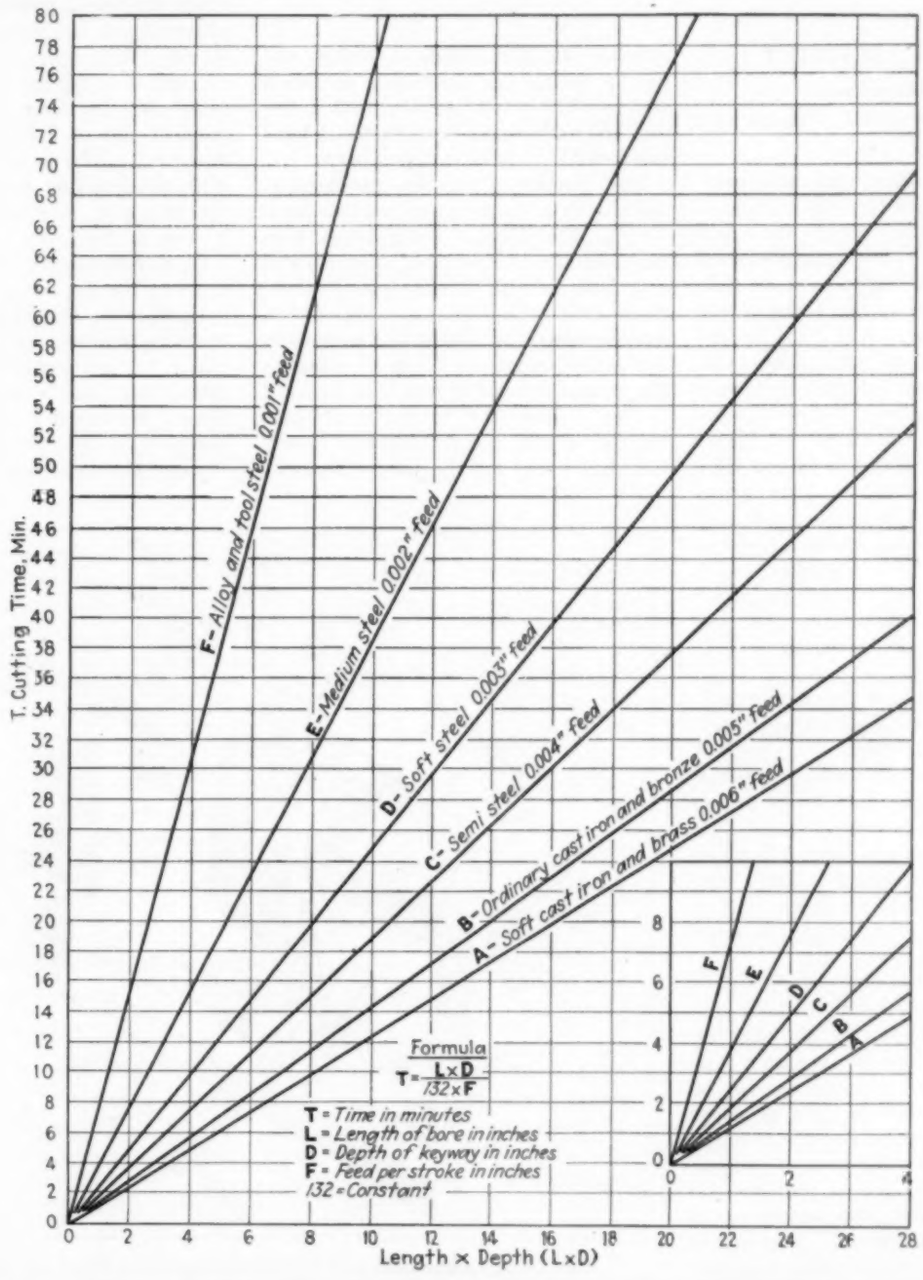
American Machinist

Reference Book Sheet

Estimating Time for Cutting Internal Keyways

INTERNAL keyways are an important part of many kinds of machinery, and a method of estimating the time required for cutting them should be of value to planners and production men. The formula and the chart have been worked out by C. W. Willits, chief engineer of Mitts and Merrill, based on experience with their keyseating machines. The formula is shown on the chart. The feeds recommended per stroke for different materials are also shown on the lines on the chart.

Taking as an example, a keyway 12 in. long and ¼ in. deep, multiply 12 × ¼ and get 3. Going up from 3 at the bottom of the chart, it is found that for soft cast iron or brass, using a feed of 0.006 in., the time required is 3½ min. For soft steel, with 0.003 in. feed, the time required is 7½ min., and for alloy or tool steel with 0.001 in. feed, 23 min. Any usual combination of length and depth can be worked out in the same way.


T. Cutting Time, Min.
Length × Depth (L×D)
F- Alloy and tool steel 0.001" feed
E- Medium steel 0.002" feed
D- Soft steel 0.003" feed
C- Semi steel 0.004" feed
B- Ordinary cast iron and bronze 0.005" feed
A- Soft cast iron and brass 0.006" feed
Formula
T = L×D / 132×F
T = Time in minutes
L = Length of bore in inches
D = Depth of keyway in inches
F = Feed per stroke in inches
132 = Constant

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Embossing Feed Pins in a Recording Cylinder

Punch and die work is substituted for staked pins in a paper feed mechanism

WALTER C. SCHMIDT
Tool Engineer,
Brown Instrument Company

IN THE recording potentiometer-pyrometers made by our company, the paper upon which the pens record temperature variations is carried by a cylinder with small pins at its ends which engage holes in the edges of the roll of paper. These pins must be extremely accurate in both shape and position. It is essential that the paper be carried along evenly, without undue strain at either side, without "hitching," and without clinging to the pins as they withdraw from the holes. This means that the pins must be domed for easy entry and withdrawal, must be placed exactly opposite their companion pins on the opposite end of the roll, and must have a tiny straight surface that will hold the paper sufficiently to pull it along over the roll.

This has been done in the past by drilling the brass roll or cylinder, then inserting and staking short pins. This method has been found unsatisfactory because pins loosen, are difficult to locate accurately and are hard to keep in exactly the desired shape. Facing these difficulties with our older models, and having a new instrument to build, we knew that a different method of feeding the paper should be devised.

I was certain that the cylinder could be embossed or "dimpled" without distortion and very accurately, and that the whole operation could be done on a production basis. It was then decided to build the die illustrated. The principal difficulty in the design was the removal of the cylinder after extrusion or embassing of the dimples, as they projected all around the cylinder and prevented its removal from the fixture. The fixture illustrated avoids this difficulty, however, by having a swing-bolted two-part clamp which separates to let the finished cylinder out, yet holds it firmly and rigidly during the embossing operation and provides exact and accurate indexing. A rubber pad beneath the hinged half permits it to be dropped open.

The dimples or pins are produced in this die by a drawing process, the metal forming the dimples being taken from the cylinder wall without distorting it and also forming a thin-walled strong dome such as that shown in the sketch. The developed thickness of the cylinder wall is the important factor in obtaining the correct amount of metal for drawing.

The cylinder or tubing is inserted through a steel sleeve rotatable in two housings which are themselves mounted on springs and positioned by guide pins. This sleeve has 18 grooves machined within it to permit the embossed cylinder to be removed. The clamp at its end is also grooved, but on one side only, since the other drops away when unclamped. Indexing of the sleeve as it is rotated is accomplished by a lever which engages each of the 18 teeth in a ring gear about it. A spring beneath the lever keeps the pawl tightly in place to insure exact indexing.

The punch is mounted on a solid block beyond the sleeve, being set into a smaller-diameter round bar keyed in place in the block. In this set-up the punch remains stationary; only the die and the sleeve move. (Any fixture in which the punch moved would be both awkward and inaccurate, and would also be difficult to make with the necessary strength and rigidity). The roll is indexed for the first dimple by a pin dropped into a hole previously drilled in the roll. The clamp is then tightened with the indexing lever in position on the ring gear, and subsequent indexing is done by the lever.

In operation, the ram or drawing head, carrying the die, descends and forces the cylinder over the punch. In order to keep the cylinder perpendicular to the punch, two plungers also mounted on the ram descend at the same time and push the sleeve support brackets down against spring resistance. Bushings are inserted to prevent overstroke of the press. As

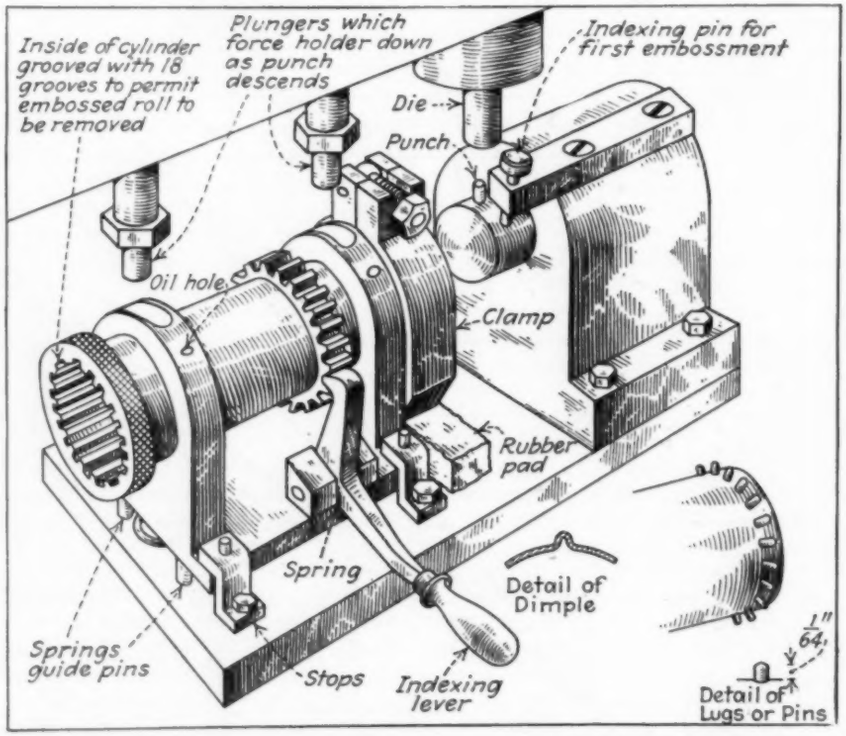


Fig. 1—A combination of roll indexing, specialized jig design, and a fixture in which the die moves down over the punch, carrying the work with it, forms dimples on calendar rolls for pyrometers

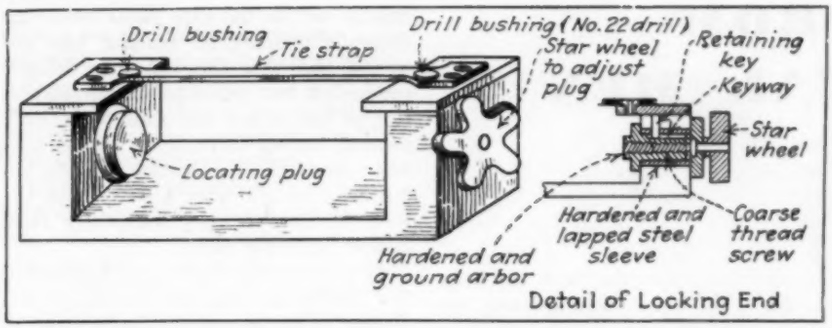


Fig. 2—A rigid drilling jig assures accurate location and alignment of the drilled holes that index the first "dimple" in the forming fixture

the ram moves up again, these springs lift the sleeve and the newly dimpled roll from the punch. The operator then indexes the cylinder for the next dimple by slipping the indexing lever and rotating the sleeve by its knurled end.

The holes drilled at each end of the roll for initial indexing are located by the small and simple drill jig, shown in Fig. 2. Though simple, it serves well to indicate the problems introduced by the accuracy required. It was first planned to drill the holes one at a time, but no jig could be devised that would insure holes exactly opposite each other. A U-shaped jig was then built, similar to that shown. A positioning plug is located in one arm of the U, while a star-wheel pushes in the other plug to locate in the cylinder. These plugs act also as supports for the section of cylinder being drilled, and since the bushings are located at a constant distance, even though the cylinder may be slightly too long, the holes will be exactly the right distance apart. Even with the heavy U of the jig, tightening up the star wheel caused a slight distortion, which threw both bushings and holes out of line. This was overcome by setting the bushings in a top tie strap.

Cylinders thus dimpled are giving good service, and have been proved several times as accurate as those made by earlier methods. The dimples are put in without distorting the cylinder wall.

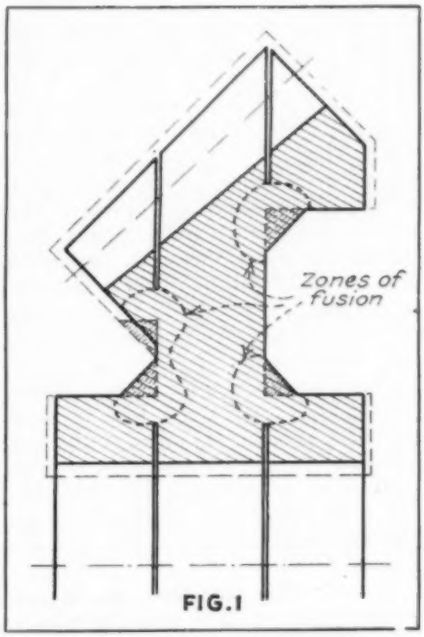


FIG. 1

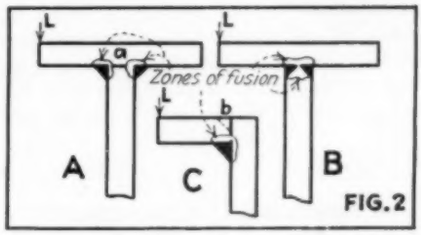


FIG. 2

When Weldings Are Specified
Discussion

FRANCIS W. SHAW

Tool and Gear Consultant, Heywood, Lancashire, England.

The designer who would reap the full advantage of a process by which his product can be considerably bettered and cheapened must realize its restrictions.

To build up toothed gears in the manner described by G. B. Cramp in an article under the title given above (*AM*—Vol. 76, page 786), savors too much of riding a hobby, for not only is it uncertain that weldings would be cheaper than forgings, but it is quite certain that the gears made from the weldings would be inferior.

Few machine builders would be disposed to risk a bevel gear, such as that shown in Fig. 1, in which the metal about the teeth and the bore is not continuous, for not only would its strength be open to suspicion, but the nicks between the parts would make admirable receptacles for cuttings and grit. Furthermore, a gear so constructed cannot be perfectly welded, because the zones of fusion do not extend through the components.

Designers who would adopt welded constructions must realize that the zone of fusion does not always extend right through thick material. Hence, in employing the welding process, regard should be had to the direction of the stresses. Disunion at or near the neutral axis of the plates of a constructed tee, for instance, is of little moment. Indeed, a tee welded as at *A*, Fig. 2, yet disunited at *a*, may be far more resistant to a load at *L*, than a tee as at *B*, where the zone of fusion runs the section at the joint. Disunion at the surface, as at *C*, may, however, be fatal. In this construction, a vee at *b* instead of the fillets would make a far stronger beam that would hardly be improvable by the addition of filleting.

In comparing constructions such as *A* and *B*, it is always well to calculate the moments of resistance, assuming the minimum fusion for zone *A* as determined by experience or experiments.

Ice Box Annealing
Discussion

ED. SEARLES

Under the above heading (*AM*—Vol. 76, page 566) the statement is made, "there seems to be a little misunderstanding in some quarters regarding the annealing of duralumin or similar rivets by putting them in an ice box." Perhaps the phrase, "annealing, etc., etc., by putting in an ice box," is the cause of the confusion in the mind of anyone not intimately connected with the use of aluminum alloys.

Duralumin has the peculiar property, when heat-treated to a temperature of 930 to 940 F. and quenched, of leaving the quench tank in a soft condition similar to that of annealed material. This condition is, however, not a permanent one, as the material ages, or hardens, rapidly for a period of approximately one hour, and then continues to age or harden at a slower rate for a period of approximately 10 days, at which time it will have assumed its original hardness.

Subjecting the material to a continuous low temperature immediately after quenching, simply delays the aging or hardening of the heat-treated material for quite a long period of time. When the material is removed from the ice box or the temperature of the material is permitted to rise, the natural aging process begins, and the material will start to harden in a normal manner.

The annealing of duralumin is another matter entirely and has nothing whatever to do with ice boxes or low temperatures. Material that has been annealed does not age.

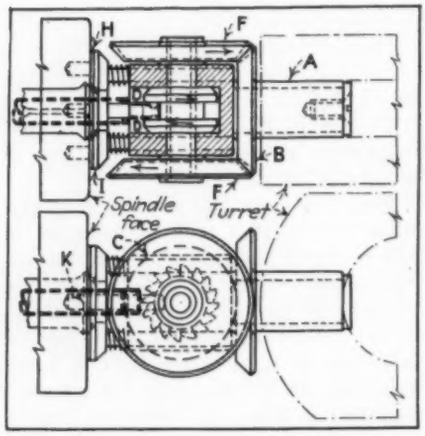
• IDEAS FROM PRACTICAL MEN

Straddle - Milling Turret Tool for Automatic Screw Machines

C. W. HINMAN
Mechanical Consultant

The sketch represents the principles of construction of a turret tool for light straddle milling in automatic screw machines. A tool of this kind is sometimes necessary where the cut is too heavy for the usual slotting attachment.

Referring to the illustration, *A* is the hollow shank of the miter gear *B*. Through this shank and revolving within it is the shank of the tool body *C*, within which are the cutters *D* mounted on arbors keyed to the miter gears *F*. Both of these gears are in mesh with the gear *B*, all the gears being outside of the tool body to prevent chip interference. The driving gear *B* is stationary and is clamped by its shank in the turret, the



gears *F* revolving about it when the tool is in motion. When the tool body revolves, the cutters revolve in opposite directions.

The ring pad *H* is made of brake lining and is attached to the steel ring *I*. Four leader pins surrounded by coil springs are attached to the ring *I* and slide within the tool body. Two other pins *K* are for revolving the body and are located diametrically opposite each other, both being secured in the tool body and fitted to slide through the ring *I* and the pad *H*. Six clearance holes for the driving pins are drilled in the face of the spindle nose and are in line with the driving pins.

In operation, after the stock has been fed against the turret stop, indexing the turret brings the tool in line with the spindle and the work. A quick rise in the lead cam advances the tool until the pad *H* contacts with the revolving spindle, setting the tool body in motion, the friction of the pad against the spindle synchronizing the speed of the pad with that of the spindle. After this action, the cam presents a reduction in the rise to give the proper feed for milling. Just before the cutters contact with the work, the driving pins *K* engage the clearance holes in the spindle, and then the milling begins. The illustration shows the work completed and the pad *H* about to leave the face of the spindle nose. While the shoulders on the work are slightly concave, this is not objectionable when the saving of an extra operation is considered. Burrs are removed by a turret tool, or by a tool held in either the front or the rear toolpost. An outside pipe (not shown) delivers oil or cutting compound inside the cutting chamber. Chips and oil are thrown out at the next indexing of the turret.

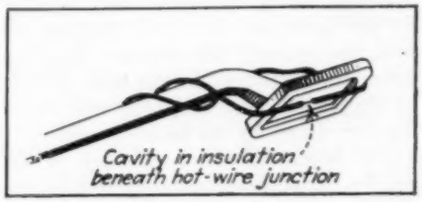
Several other operations can be performed by this tool by changing cutters. When slab milling one side of a shaft for a setscrew to bear against, a blank in place of one of the cutters supports the work opposite to the cut. Slots can be cut in the end of wo , either in or off the center, or an arc or a V can be cut.

Accurate Temperature Measuring Device

W. J. VOSS
Master Mechanic,
Union Metal Products Co.

In measuring the temperature of heated flat plates approximately 6x8 ft. in size, we experienced considerable difficulty in getting anything approximating accurate results. It was essential that the reading be gotten almost instantly as the red-hot plates passed between furnace and press, in order not to delay production. The commercial equipment we had available embodied a thermocouple at the end of a long handle. The junction of the wires was backed by the usual insulating slab. We found that it was necessary to heat the insulating slab as well as the wire joints before an accurate temperature reading was obtained, and that this not only delayed production but permitted air circulation to cool the surface and form scale, both causing further innaccuracy in the ultimate reading. The insulation slab, being flat, did not form a seal about the joint or force it into sufficiently close contact with the plate.

After some experimenting, I hollowed the insulating slab as shown in the sketch. This permits the wire joint to come in close contact with the plate while the hollow in the slab forms an enclosure which prevents air circulation



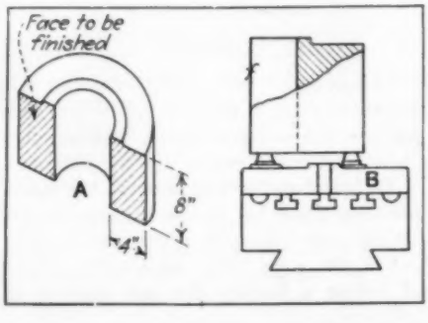
and permits the radiant heat to bring the air about the couple to plate temperature almost instantly. We have been using this modification for some time now with very good results, and a number of other plants which have copied the idea report it similarly satisfactory.

Holding Work for Milling With Tungsten-Carbide Cutters

DUDLEY L. CURTIS

In milling with tungsten-carbide cutters, it is bad practice to have the work rest on its rough surface. Work so mounted has a tendency to rock, regardless of how many clamps are used or how solidly it appears to be held.

Not long ago, we had to mill the joint faces of some large cast-iron bearing caps weighing 75 lb. each, one of which is shown at *A* in the illustration. A 10-in. full-back tungsten-carbide cutter was used, removing 1/8 in. of metal, the caps being held with their rough sides directly on the machine table. Four heavy clamps were used and the caps appeared to have a solid bearing, though the finished surfaces had slight



chatter marks, indicating looseness. The same job had previously been done with high-speed steel cutters and the finish was satisfactory, but, of course, both the feed and the speed were much less than with tungsten-carbide cutters.

To prove the advantage of rigidity, a light cut was taken on the bearing surfaces of several of the caps to insure a solid support. Then the joint faces were milled, using the same method of clamping as before. There was a great difference in the results. The solid sound made by the cutter indicated rigidity—the outstanding requirement for milling with tungsten-carbide cutters. Where the limiting feed had been 15 in. per min. before, we were now able to increase it to 32 in. per min. This shows that methods of milling with tungsten-carbide cutters are different from those where other kinds of cutters are used, and that traditional practice cannot be followed. It's a case of determining what is basically needed and making what changes are necessary.

For the job referred to, we made the inexpensive fixture shown at *B*. It had three hardened buttons on which to rest the work. With this fixture, vibration and rocking of the work was eliminated without having to mill the faces of the caps on which they rested. You can't have the work rock and expect to do a good job with tungsten-carbide cutters at their best speeds and feeds; it's rigidity that counts.

A Machine for Graduating Micrometer Collars

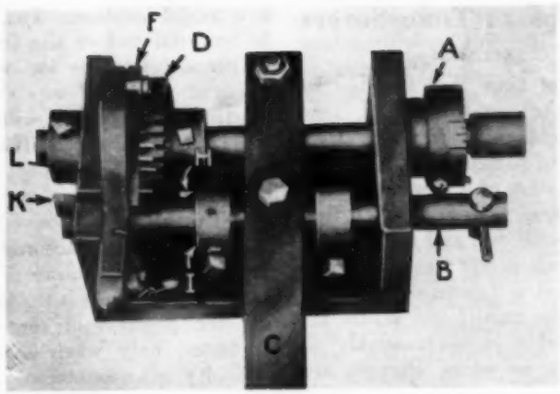
AVERY E. GRANVILLE

The illustration shows a hand-operated machine for graduating micrometer collars such as are to be found on the actuating screws of nearly all machine tools.

The collars to be graduated are placed on the end of the arbor against the collar *A* and are held by the knurled screw-plug to be seen at the right. The end of the arbor is slit in several places and the screw-plug is tapered to expand the arbor end in the holes of the collars. The tool for cutting the graduations is held in the sliding bar *B*, which is moved back and forth by the lever *C*. The index wheel *D* is attached to the arbor by a setscrew and is operated by the pawl *F*. In the front face of the index wheel are slots of different depths, corresponding to the lengths of the lines on the collars.

Movement of the lever *C* to the left causes the lug *H* on the collar *I* to enter one of the slots in the face of the index wheel, permitting the tool to cut a line as long as the depth of the slot. Movement of the lever *C* to the right causes the tool to clear the work, and at the same time causes the wedge-shaped piece *K* on the end of the sliding shaft to raise one end of the pivoted lever *L*. The pawl attached to the opposite end of this lever then rotates the index wheel one notch, indexing the work and bringing the next slot in the face of the index wheel in line with the lug *H*. When the lever *C* is again moved to the left, the wedge-shaped piece *K* is moved from under the end of the lever *L* and the lever is pulled back by a spring, and the pawl drops into the next notch in the index wheel. Continuing this movement, the lug *H* enters another slot in the face of the index wheel and the tool cuts a line of the length of the depth of that slot. This cycle is repeated until the graduations have been cut all around the collar.

After a collar has been clamped on the arbor and the tool has been adjusted for depth of cut, all that is necessary is for the operator to move the lever *C* back and forth, the other movements being entirely automatic.



Hardening Long, Slender Tools

CHARLES KUGLER

In spite of the extreme care in hardening long, slender tools such as broaches and reamers, some of which were but ½ in. in cross-section and as long as 2 ft., they would warp to such an extent that some of them had to be scrapped, and others required much time and patience to straighten.

The writer suggested that after being heated, such tools be held in an electric drill running at the highest possible speed and quenched while revolving. My suggestion was laughed at until I proved the soundness of the method in the following way: A piece of ⅜-in. drill rod, 2 ft. long, was heated in the usual way and was then put into an electric drill. The drill was run at high speed and the rod was quenched in water, dipping it vertically. The rod came out of the water surprisingly straight. Then other tools were quenched in the same way with equally good results.

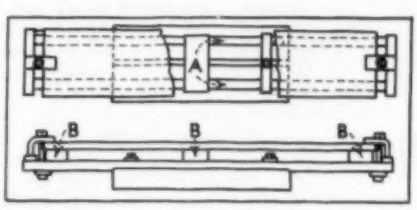
At the plant where I am employed, all long, slender tools are now quenched in this way and, while it is necessary to straighten some of them, the method is a great improvement over the old way of quenching.

Extending a Milling Machine Table

H. MOORE
Hamilton, Ontario, Canada

Some time ago we received an order to mill two slots in the center of some pieces of boiler plate. The plates were longer than the table of our milling machine and so wide that they covered the T-slots, so that we could not clamp them to the table. It seemed as though we would either have to refuse the order or else send the job to some other shop that had a larger milling machine. Finally, however, we hit on the idea of extending the table of our machine, which we did as shown in the illustration.

Two shafts *A* were clamped in the T-slots nearest the edges of the table and three parallels *B* were laid on them crosswise to prevent the clamps on the shafts from interfering with the work. The work was laid on the parallels and clamped at each end, the straps for the clamp bolts being under the shafts, while the straps for the heels of the clamps were on top.



Project Slips as Time Savers

H. L. LACKMAN

The saving of time that is often so essential in the production of new models of machines is a factor that favors the use of project slips.

In the fabrication of a new model airplane, the general procedure is to furnish the shop with dies and typical sections of the fuselage and then to permit the shop to develop its own details from the layout in the mold loft. Where interferences develop in the assembly of the new model, or where changes are found to be necessary or desirable, they are recorded on project slips for use in the shop, instead of finished drawings. The slips are either typewritten instructions or mere sketches that the shop must work to under the direction of the project engineer and the foreman. They are signed by the project engineer and approved by the chief engineer before being issued to the shop. When issued, they give authority for the work to be done.

The project slip illustrated covers an actual case and was made out to give the shop instructions for making changes in the instrument panel of a new model airplane. The panel was to be removed and its size to be cut down to permit clearance for other members adjacent to it. It was then to be relocated in accordance with the instructions on the slip. The data were arrived at by the engineer in accordance with actual measurements on the plane.

When the slip is received by the shop, the work is done according to the instructions it contains. Usually, the engineer's presence is not necessary during the progress of the work, and is requested only when some unforeseen difficulty is encountered.

ENGINEER'S PROJECT SLIP.

No. Of Project Slip - XY No.80.

Name Of Project - XY Plane No. 616

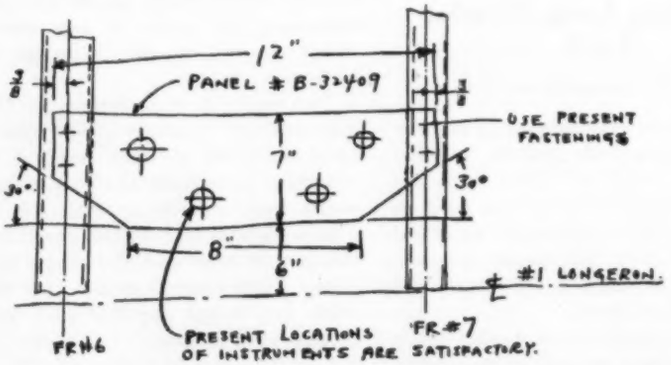
Schedule No. - 706

Date - 3-2-30

Project Engineer - John Peters

Subject - Modification of Instrument Panel- Fr.6 - 7.

1. No. 2 Shop Modify Panel No.B-32409 as follows:



2. Remove instrument panel and cut to dimensions shown above. Repaint and refinish in accordance with P.S.No.XY No.16.

Signed John Peters
Project Engineer.

Approved ROLAND SMITHING
Chief Engineer.

Two Tricks in Punching

W. J. TANGERMAN

Shop Superintendent, Union Metal Products Co.

Some time ago an order was received that required a ¾-in. punched hole at the center of a depression such as that indicated at *A* in Fig. 1. For a time we thought it would be necessary to perform two operations to achieve this result, one forming the depression and the other punching. By using a die

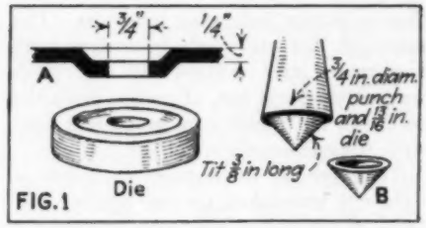


FIG.1

such as that illustrated, together with a standard punch, both operations were performed simultaneously. The punch drew the metal to the shape desired, then punched the hole, and without undue wear or strain on tools or machine. We noticed something else also, that the punched section did not require stripping. This was apparently caused by the stretching of the metal during punching which caused the hole to be a very small amount larger than the normal punched hole.

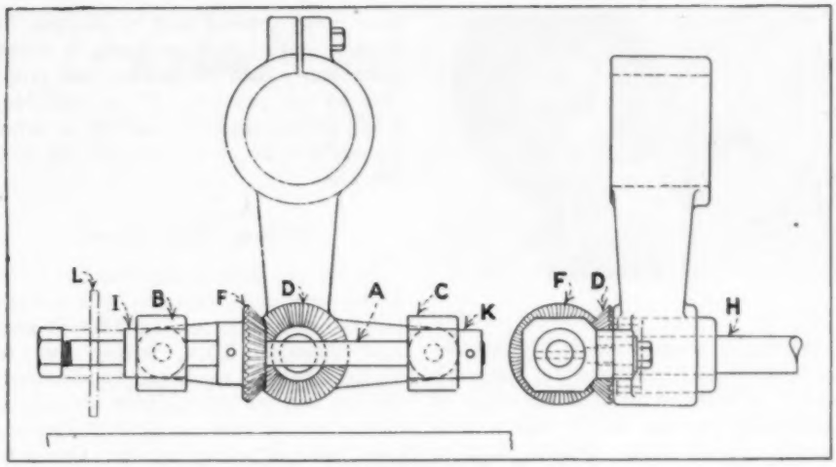
Working on that theory, we developed punches of the type shown in Fig. 2, and are now using them on all single punching work. The punch differs from the usual punches only in the lengthening of the tit as indicated. Most of our punching is to center punched marks, and must be as accurate as possible. The lengthened points permit the operator to gage the hole more accurately. Also, many holes must be punched at the bottoms of deeply corrugated sections in 6x8-ft. sheets ¼-in. thick. This would require an adjustable stripper or some similar arrangement. This type of punch with the standard die, however, punches a clean, sharp-edged hole without distortion and comes out without using a stripper; in fact, the operator can punch holes of any size in a small plate without a stripper of any kind, and without the plate rising from the die. The punching is shown at *B*.

Attachment for Cutting Racks

WILLIAM COLCLOUGH

Having to cut some racks and not having any rack-cutting attachment for our milling machine, we made the simple attachment illustrated. It consists of the auxiliary arbor *A* carried in the two bearings *B* and *C* that are attached to the support on the overarm; the two miter gears *D* and *F;* the necessary spacing collars; and the nut.

Gear *D* is attached to the regular arbor *H*, and gear *F* is pinned and keyed to the auxiliary arbor. The shoulder *I* on the auxiliary arbor and the collar *K* at right-hand end are in contact with the outer ends of the bearings and prevent end motion. The cutter *L* is carried on the auxiliary arbor, there being room for a limited number of spacing



Attachment for cutting racks

collars between the shoulder and the nut. Indexing is done by moving the table longitudinally by the traversing screw, reading the amount of advance by means of the usual micrometer collar.

An Unusual Milling Operation

F. H. MAYOH

A production job that required a radius to be milled close to a shoulder made it necessary to design the fixture illustrated.

An end view of the work as it is held in the fixture is shown in the heavy dotted lines in Fig. 1, the radius to be milled being indicated at *A*. A lug on one end of the work fits between the walls of the fixture, while the under side of the part to be milled fits over the rib *B*. The holding part of the fixture is held in the cradle *C*, Fig. 2, which is mounted on trunnions fitting the bearings *D* and *F* in the base. The cradle is swiveled by worm gearing operated by a handwheel, its circular travel being limited by stops to 180 deg.

The work is located endwise by the stop *H*, against which it is pushed by the spring-operated plunger *I*, the stop being curved to fit the end of the work and hold it down. At the opposite end, the work is held down by the clamp *K*, the screw of which also locks the plunger in the position in which it is held by the spring, thus the work is held securely.

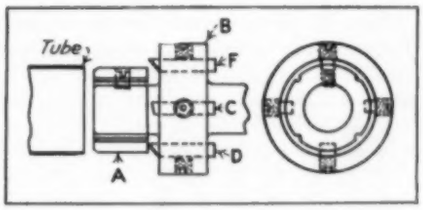
In operation, the machine table is set to a stop that brings the vertical center of the work under the center of the cutter. Then the handwheel is turned, rotating the cradle and the work 90 deg. to a stop. After setting the work for the correct depth of cut, the machine is started and the cradle is rotated 180 deg. in the opposite direction, thus milling the work to one-half of a circle. No attempt has been made to show all the minute details of the fixture, since the multiplicity of lines would be confusing where one major view only is shown.

Facing and Burring Tubes in the Turret Lathe

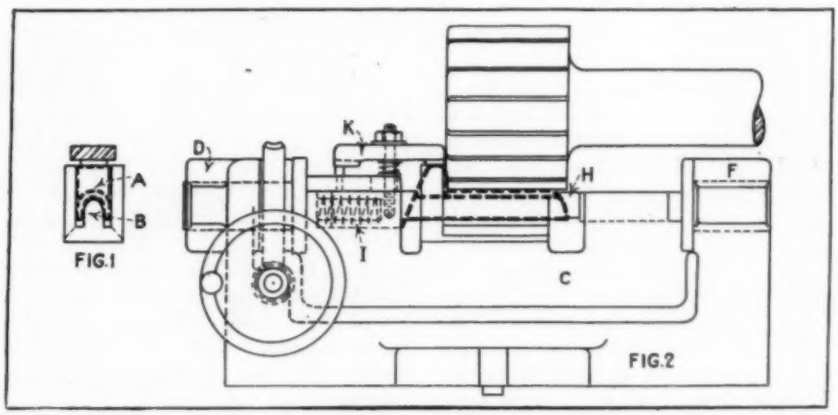
JOHN I. BLAIR

We had a large quantity of seamless steel tubes of different diameters to face to length and to burr inside and outside. The tubes were for the rollers of lawn mowers and were run through in lots of from 100 to 1,000. At first the work was done in an engine lathe, one end of the tubes being held in the chuck, while the opposite ends were supported in the steadyrest. The tubes had to be accurate in length and faced square with the axis, as end castings supporting bearing pins were to be forced in flush with the ends, and the pins must run true to prevent binding in the roller bearings in which they were to run.

Finding the engine lathe too slow for the job, we made the tool illustrated and did the work in the turret lathe, increasing the production about 300 per cent. One end of the work was held in a wrenchless chuck, while the opposite end was supported by the pilot *A* on the end of the tool, eliminating the use of the steadyrest. The pilot was smaller in diameter than that of the inside of the smallest tube and removable bushings were used to suit tubes of different inside diameters.



Four slots were milled in the body of the tool to receive the cutters, and the ring *B* was drilled and tapped for four setscrews and then pressed on the body so that the tapped holes came fair with the cutter slots. The two opposite cutters *C* were square ended for facing the tubes to length, while the other two cutters *D* and *F* were ground to opposite angles for the inner and outer burring.



Equalizing Pressure of Vise Jaws—*Discussion*

FRANK W. CURTIS
Research Engineer,
Kearney & Trecker Corporation

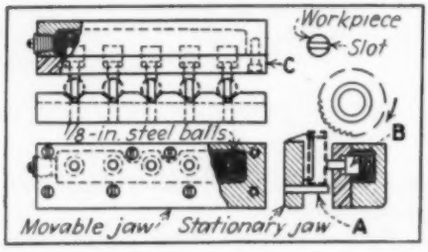
The vise jaws described by Francis Paquin in an article under the title given above (*AM*—Vol. 76, page 948), although not new, are well suited for a large variety of small parts requiring light cuts. However, as explained by Mr. Paquin, the wax used for equalizing the pressure is likely to be melted by the heat generated in cutting and to leak past the plungers unless insulation is provided or the plungers are packed.

I have used a number of vises of this kind, but much prefer the use of steel balls instead of beeswax or tallow, and they provide a good method of equalization. When the balls are inserted in the chamber provided for them, it is well

to include a generous supply of vaseline or a light grease for the purpose of not only filling the spaces between the balls, but to act as a lubricant as well, so that the balls will "flow" readily as pressure is applied. It will be found that the balls will outlast wax and that they will require very little attention after the proper adjustment has been made.

The means of end location used by Mr. Paquin is a flat plate on which the work rests. For this, I have found hardened pins much better than a flat surface, primarily from the standpoint of cleaning. With the flat plate, chips will lodge on the locating surface when the work is removed and must be blown or brushed off before new work is inserted. With pins, as at *A* in the illustration, chips will not interfere with location, and with the form of construction shown it will be possible to blow off the chips, even while milling.

Straight plungers are shown in Mr. Paquin's illustration and they are ap-



parently held by small pins in elongated slots. This construction can be modified advantageously by the use of shouldered plungers, as shown at *B*, which are assembled by making the front part of the movable jaw a separate piece, as at *C*. The shoulder on the plungers has two advantages. It prevents them from coming out and affords a larger area of contact with the balls, or even the beeswax if it should be used in preference, naturally providing better and more positive clamping. These improvements are not offered in unjust criticism of Mr. Paquin's design, but rather as refinements of tool design based on experience with equalizing jaws embodying a principle that can also be applied to general fixture design for use with equalizing clamps and fixtures.

An Adjustable Attachment for the Floor Grinder

EDWIN KILBURN

The attachment illustrated is quite useful on many odd jobs of grinding that require the work to be straight and at a certain angle, but which are not sufficient in quantity to warrant the purchase of a regular knife grinder.

As the illustration shows, the attachment is an adjustable rest for the work and is so constructed that the angle of inclination may be varied over a wide range. An adjustable stop is fitted to slide along the rest and is operated by a screw through a small hand knob. The whole attachment can be removed by loosening one bolt. When in use it replaces one of the regular work sets.

SEEN AND HEARD

JOHN R. GODFREY

Watch Set-Up and Handling Time

Set-up time and handling time are two items that too frequently do not receive proper attention. I recently ran across a battery of special machines that were idle because the quantity of work needed did not pay to set them up. The work was being done on machines that were not quite as fast as the specials but which could be set up in much less time. In the same shop they were using single spindle drills instead of setting up the big multiples, and for the same reason. Time study men who know their job pay fully as much attention to set-up work and handling and idle time of machines as to the actual cutting time, because it is usually easier to make actual savings on these phases of the job.

The Shop Free-Lance

One of my hobbies has been that every shop of any size ought to have a first class practical mechanic as a free-lance. He should have no details but be free to roam the shop and designing room at will. I'm tickled to find one large shop that has been doing this for years. This man wears no high-falutin' title. He reports to the production manager and the chief inspector, but he is only responsible to the big boss. When things go wrong he finds the answer. But how many things he prevents from going wrong, not even he probably knows. The right kind of a man, and he must have great gobs of tact in addition to being a crack-a-jack mechanic, is worth more money than the directors will probably let you pay him. If you paid him a fair percentage of the money he saves he might draw more than the big boss himself.

Rolling Your Own!

In the old days in the shop we made all our own parts, down to bolts and set screws—each shop making different sizes and threads. Then, largely due to William Sellers, we began to standardize and buy such parts from specialists. Since then we have waves of "rolling our own" parts or buying outside. One auto builder starts to make all his own parts, another buys most of them and is largely an assembler. Then the first buys many parts and the second starts to make his own—each giving what he considers a good reason for so doing.

Most builders of elevators make their own motors, when it would seem that specialists in motors could build them cheaper. Now an oil burner maker starts to save money by "rolling his own"—to save money for his customers. If he can build them cheaper than a specialist it looks as though the specialist was missing several bets in the way of equipment. It seems as though the specialist can save him as much money as the man who makes his drills, reamers and taps, not to mention gears and other parts. From the way we play see-saw with centralized manufacture and decentralization, it looks as though we lacked a lot of definite data on costs.

Fly-Cutters for Finishing Cylinders

Finishing cylinder walls has been a problem ever since the internal combustion engine dawned on the horizon. Lapping with dummy pistons and Sapolio was one of the early "refinements." Then came rolling with a tube-expander-like tool, and grinding with a planetary type of internal machine. This went out in an amazingly short time after having seemingly become a fixed method. Now there is talk of going back to boring with a fly cutter. The reason given is that the hone is not always kept sharp and that when dull, it forces the fine, dust-like particles of iron into the cylinder wall. Here they wait a chance to work their way out into the cylinder bore and score the walls. There is little doubt as to the good work that can be done with a sharp fly cutter, but the hone has certainly finished a lot of mighty nice cylinders. And it is quite possible that the indictment against the hone is imaginary or self-interested.

SHOP EQUIPMENT NEWS

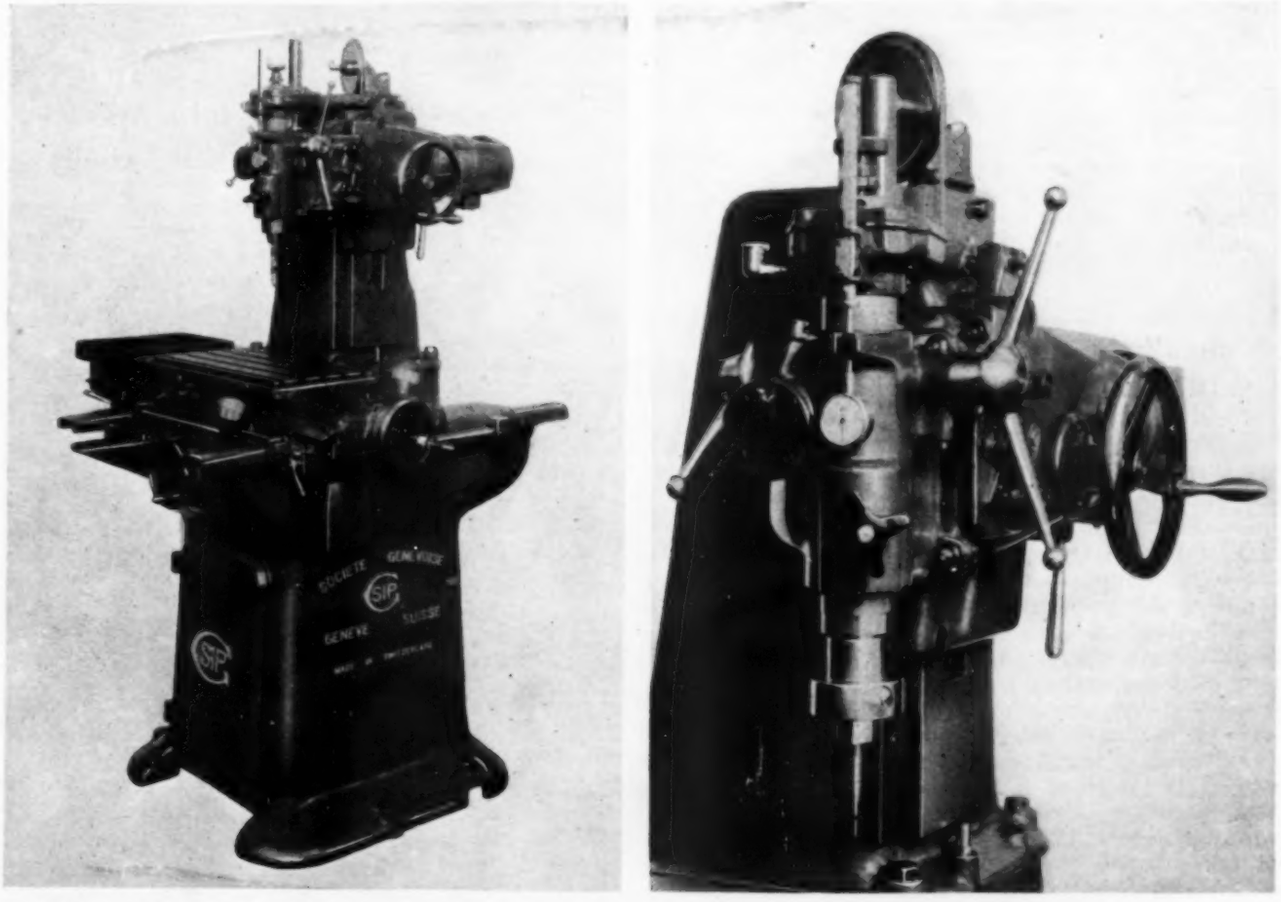
Société Genevoise Model MP-2C Precision Jig Boring Machine

A precision jig borer for laying out, drilling and boring of holes in the light mechanical industries has been placed on the market in the United States by the Société Genevoise of Geneva, Switzerland, through their agent, The R. Y. Ferner Co., Investment Bldg., Washington, D. C. This machine is designated as the Model MP-2C. It has capacity for boring holes in an area of 8x12 in., and has a maximum space between the work table and the nose of the spindle of 13½ in.

A feature is the method of support and movement of the work table on the bed of the machine. The bed is of the pedestal type. The work table measures 10¾ x 18 in., and is part of a table much longer than this that has wide flat ways on its lower surface. These ways rest across similar flat ways on the bed of the machine so that the work table is free to move in either coordinate.

The work table is guided by a second slide partially surrounding it, which likewise has wide flat ways and rests on the bed of the machine, but does not support the work table. This guiding frame has a leadscrew for moving the frame lengthwise of the ways of the machine, and is fitted with self-adjusting clamps, operated by a single handle, for clamping the frame to the ways of the machine bed and for holding the frame at right angles to the machine-bed ways. Another leadscrew is mounted in the underside of the work-table slide, its nut being connected to the guiding frame, for guiding the work table longitudinally with reference to the guiding frame. The work table can also be clamped to the other slide by self-adjusting clamps. This construction assured a firm and stable support of the work table without overhang.

The two leadscrews, the ways and the micrometer heads attached to the leadscrews are completely inclosed. The micrometer heads read by vernier to 0.00005 in. as on the larger Société Genevoise jig borers. It is guaranteed



Left—Société Genevoise Model MP-2C Precision Jig borer for holes as small as a No. 57 drill and for boring as large as 1¼ in. Right—The boring head slide and the spindle and quill are separately counterpoised by the same weight

by the manufacturer that the maximum errors of the spaces between holes will not exceed 0.00015 in.

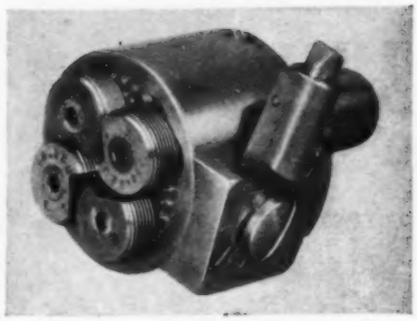
The slide on the vertical column, which supports the boring head, carries a ½-hp. motor and a six-speed gearbox. A single weight suspended in the vertical column counterbalances both the slide and spindle separately. A differential lever is used to distribute the load to the two elements.

Spindle speeds range from 190 to 3,000 r.p.m. The machine will drill holes as small as No. 57 or as large as 0.6 in. in cast iron, or 0.5 in. in steel, while boring can be carried to 1⅝ in. The spindle has a 4-in. feed. Power feed may be 0.004 in. per revolution, or hand feed may be employed. A No. 1 Morse taper is bored in the spindle for drills and end mills. The adjustable boring tool and microscope are aligned and supported by means of an external taper. A guide bushing holder is fitted at the side of the boring head. Other accessories include a dial indicator device for aligning or centering jobs, an automatic center punch, a reference square for setting the spindle on the edge of the work pieces and a three-jaw precision chuck.

A device for measuring accurately the depth of holes or counterbores or for general vertical measurements is installed on the boring head. A circular table is furnished for performing work or making measurements in polar coordinates. The table has a diameter of 11.8 in., and can be set to 5 seconds of arc by vernier. Floor space occupied is 45x45 in., and the height of the machine is 64½ in. Net weight, without the circular table, is 1,550 lb.

"Namco" Circular Chaser Diehead for B&S Automatics

Type DBS "Namco" self-opening die head with circular chasers has been developed by The National Acme Co., 170 E. 131st St., Cleveland, Ohio, to fit Brown & Sharpe automatics. While designed to give greater chaser life, the use of the circular forming tool principle enables the operator to secure better thread finish due to the natural cutting clearances of the circular tool. These chasers are reset and reground according to predetermined micrometer measurements in the toolroom on the chaser blocks that are used in the diehead. This enables the operator to put the chasers and blocks in the diehead and start production immediately without adjustment for length, and without disturbing the cutting face location. Adjustment



for snug or loose fit can be made without removing the die, and the chasers and chaser blocks can be removed or replaced quickly.

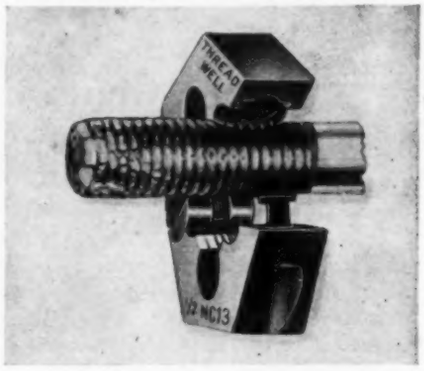
The tool is arranged so that it is automatically closed just before the threading operation in the threading position. Compensation is provided in the shank to offset possible variation in tool-slide travel due to cam wear. Minimum cutting diameter is 0.056 in. and chasers may be had in either the milled or ground thread. Ground thread chasers may be furnished to cut as fine as 80 threads per inch.

Carboloy Tool Manufacturing Kit

Carboloy Co., Inc., Detroit, Mich., has announced a tool manufacturing kit designed to enable job-shops, small manufacturers and others with short-run production of highly diversified nature to use Carboloy tools more extensively. The standard kit contains brazing and cleaning materials and an assortment of Carboloy tips and shanks for making four Carboloy tool sizes ⅜ in. sq. x 2½ in.; ½ in. sq. x 3½ in.; ⅝ in. sq. x 4 in., and ⅝ x 1¼ x 8 in. Shanks are recessed to fit the Carboloy tips for either right- or left-hand use. Through the development of a method for safely removing the tips from the shank, the user may change the tool style and size whenever desired.

Threadwell Hexagon Opening Die

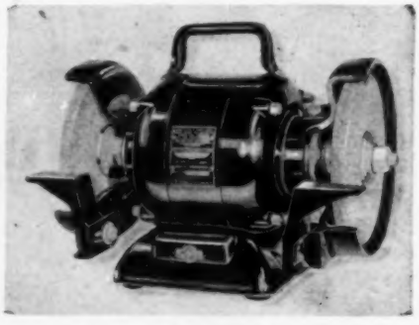
The hexagon opening die announced by The Threadwell Tool Co., Greenfield, Mass., opens instantly at the end of the cut and is removed without backing off. It is adjustable for tight or loose fits. To restore jammed threads



the open die may be placed over a jammed bolt back of the bruised section, where it is locked and then backed off. One-half turn of the lock screw opens or closes the die. The die can be used with a diestock or common nut wrench. Screw sizes are ¼ to 1¼ in.

Van Dorn 6-In. Special Electric Bench Grinder

The Van Dorn Electric Tool Co., Towson, Md., has announced a 6-in. special electric bench grinder, which has balanced rotating parts to keep down vibration. It is portable, and is furnished with two grinding wheels, one



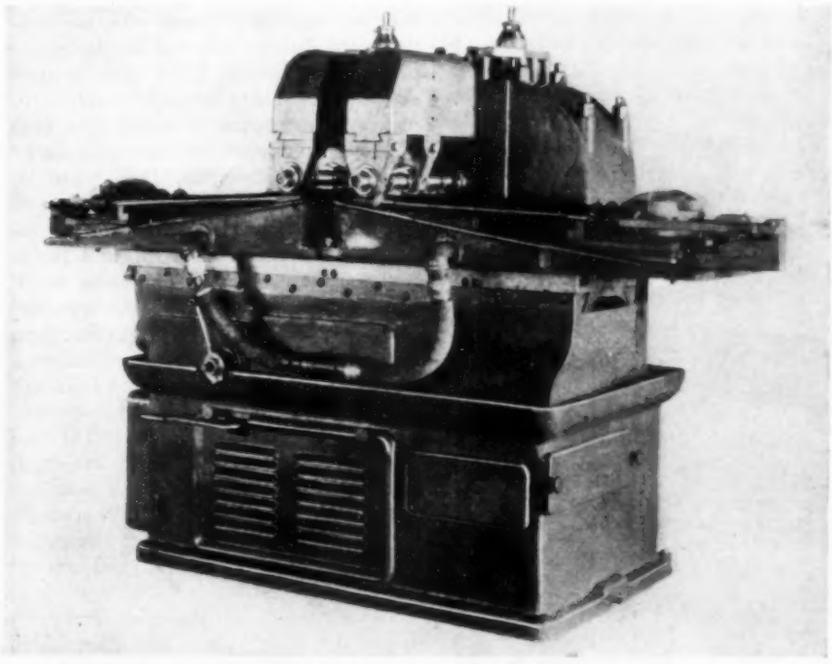
coarse and one fine, with ½-in. faces. There are two adjustable toolrests and two adjustable wheelguards. This grinder differs from the present 6-in. machine mainly in that it is equipped with bronze sleeve bearings, whereas the standard machine is a full ball-bearing unit. The bench grinder is finished in red.

Producto-Matic Milling Machine

A table traveling horizontally and automatically and cutter heads traveling vertically and automatically are combined in the No. 120 Producto-Matic milling machine announced by the Producto Machine Co., Bridgeport, Conn. As now presented, the machine has two columns and two cutter heads so that two groups of parts can be set on the table and generally mounted on each end. In this way, two sets of parts are alternately milled; that is, the operator can be loading and unloading one group of parts at one end of the table while the other group of parts is being milled. The table travels automatically to present the second set of parts to the cutters and thus eliminates to a large extent the handling and loading time ordinarily required. If desired, the machine can be made for three or even four columns and cutter heads.

In general, the cutter head travels vertically to bring the cuttters into the exact depth of cut required and retains its position while the table travels horizontally to finish the main portion of the cut. The cutters can be arranged, however, to leave the work at any desired point and to return again, if necessary. An example of this would be two sets of keyways milled in the same shaft at different points. For other operations than keyway milling, the amount of stroke or travel can be lessened, production can be speeded up, and the milling finish in the cut can be improved if the cutters can first mill to depth before the table travels horizontally.

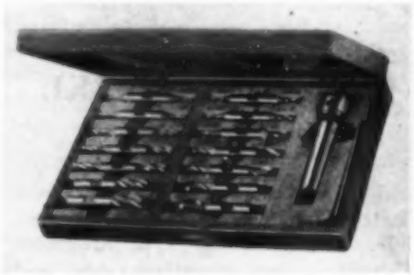
Standard size and type of cabinet base used for other Producto-Matic milling machines is used for this No. 120 model. The main gear case or transmission is a separate unit at the rear. The bed, mounted on the cabinet base, is 70 in. long by 20 in. wide and receives the drum cam from which the automatic operation of the table originates. The table is 76 in. long by 18 in. wide and is machined with three standard slots. The spindle has a standard milling machine taper on the driving end and the nose is slotted also for driving. The spindle is hollow throughout to provide for a drawbar. It is driven by a worm. Two bronze bearings carry the spindle, and the spindle worm drive shaft rotates on ball bearings, and the cutter spindle drive shaft on Timken roller bearings. The feed mechanism provides horizontal movement of the table of 8 in. for each group of parts at each end of the table and a vertical travel of 4 in. for the cutters. Convenient control of the machine is had because the starting lever and clutch feed lever are directly in front of the operator. Feeds and speed gears can be quickly changed. Forced-feed lubrication to essential points of the machine has been furnished.



Keyways in four rear axle shafts, made from a special alloy steel with a Brinell hardness of 364 to 418, are cut on this Producto-Matic No. 120 milling machine by a cycle in which one cutter feeds to depth, the table feeds to the end of the cut, the cutter head rises, and the table feeds so that the other group of parts is positioned below the second cutter head, which then feeds down vertically and the table traverses through the cut, the second cutter head rises and the table returns to the starting position. This cycle permits continuous operation of the machine, because the operator unloads and loads parts at one end of the table while work is done at the other end.

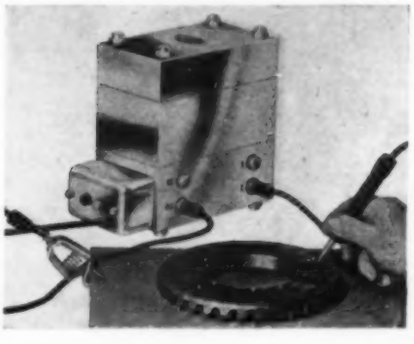
"Wel-Don" No. 1 End-Mill Tool Kit

Manufactured by The Weldon Tool Co., 1426 W. Third St., Cleveland, Ohio, is the "Wel-Don" toolroom kit No. 1, which offers a method of preserving end-mills from loss and damage. It contains a complete set of end-mills, both roughers and finishers, from ⅛ to ½ in. inclusive, together with a wrench and toolholder which takes the ⅜-in. parallel shank with which all the mills are provided. The end-mills from ⅛ to ⅜ in. inclusive are of the double-ended type.



Luma Master Etchtool

From extra light to extra heavy and deep marking can be done with the "Master Etchtool" announced by the Luma Electric Co., P. O. Box 132, Toledo, Ohio, because as many as 24 different stages or variations of control are furnished for regulation of the depth of marking. Thus, the proper quality of marking can be obtained for each



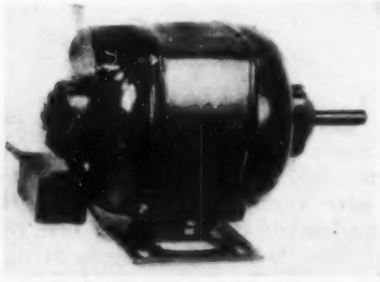
kind of job. The extra light marking is suitable for feeler gages, machinist scales, micrometers, and fine tools, whereas the extra heavy and deep marking is satisfactory for rough and unfinished iron, cast iron, forgings, bar stock, steel plates and unmachined parts that require intense heat to break through the scale.

The etchtool is designed for continuous production work. The apparatus is made so that two marking pencils can be attached. Thus, on heavy work the operator can alternate from one pencil to the other as they get hot. The extra heavy stage is so hot that it will fuse ¼-in. bar stock and can be used for soldering, spot annealing, tool hardening, light welding, and brazing. Hardening punches can be done and the shank can be left soft. The outfit operates on 110 or 220 volts, 60 cycles a.c.

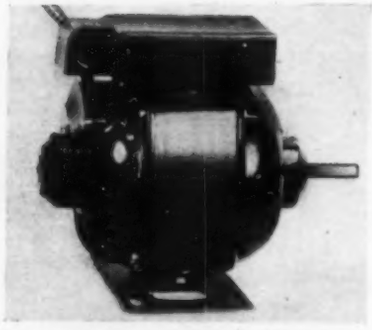
Leland Type KS and KL Motors

Two types of split-phase motors have been added to its line by the Leland Electric Co., 1501 Webster St., Dayton, Ohio. The split-phase Type KS motor is made in two mountings, rigid and cradle rubber spring mounted, and is recommended for quiet operating characteristics, normal torque, and light starting torque. It is suitable for such duty as ventilating equipment, oil burners and fans.

The Type KL is an electrolytic-start, split-phase motor made in both rigid and cradle rubber-spring mounted models. The box containing the electrolytic condenser is fastened to the top of the motor stator. Start to run changeover is accomplished by a specially designed mechanical switch similar to that used on the Type K capacitor. Motor is available in $\frac{1}{8}$, $\frac{1}{6}$ and $\frac{1}{4}$-hp. ratings.



Leland Type KS motor with quiet operating characteristics

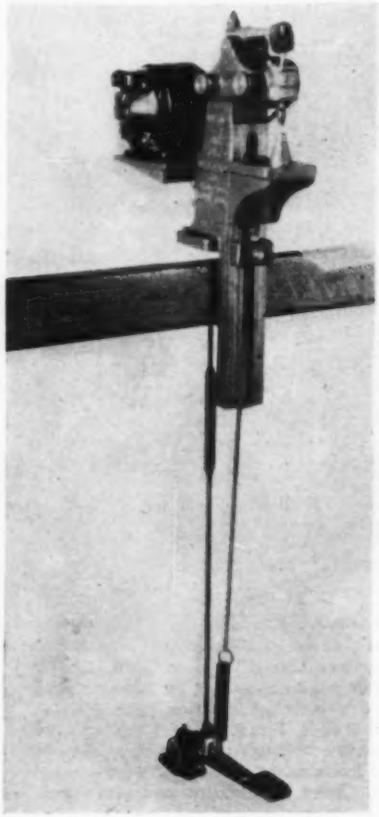


Leland Type KL electrolytic-start motor in ⅛ to ¼ hp. ratings

Grant No. 1-A Rotary Vibrating Riveter

A small high-speed riveting machine capable of driving cold $\frac{1}{16}$ to $\frac{5}{32}$ in. rivets has been added to its line by the Grant Mfg. & Machine Co., Bridgeport, Conn. This No. 1-A machine, illustrated, is obtainable in a bench model or mounted on a pedestal. It is known as a vibrating riveter, because the hammer spindle is caused to vibrate in the vertical direction 2,500, 3,000 or 3,500 times per min. as required by the rivet size.

The motor on this machine is mounted directly back of the head on an adjustable bracket, so that stretch of the V-belts can be taken up as required. Three speeds are obtained from the three steps of the V-belt drive. An eccentric bearing on the main shaft gives the connecting rod a reciprocating motion. This connecting rod passes through the thrust box at the rear end of the helve, thereby transmitting the reciprocating motion to rubber cushions, which in turn act on the thrust box causing the helve to vibrate in the hammer spindle. A brake is provided to stop the hammer spindle in its uppermost position. Tool or peen is threaded onto the spindle, in accordance with the company's standard practice. Gap is $3\frac{3}{8}$ in., and depth between the tool and the table can be adjusted to 14 in. Either flat or horn tables can be had. Zerk lubricators are placed at important points.



Anaconda Beryllium Copper

Beryllium copper in wrought commercial forms is now a product of the American Brass Co., Waterbury, Conn. The principal physical advantages of this alloy are high tensile strength, high fatigue limit and hardness. An alloy containing 2.25 per cent beryllium is standard. At the present time, the production of the alloy will be confined to sheets, strips, rods, wire and tubes in sizes and gages in which phosphor bronze is ordinarily furnished. It will also be available in the form of die-pressed forgings within certain manufacturing limitations.

Fatigue resistance of beryllium copper is exceptional. A certain spring was deflected 6,000,000 times with no indication of failure, whereas similar phosphor-bronze springs failed after 400,000 deflections. The electrical conductivity of beryllium copper is higher than that of steel, phosphor bronze and other high-strength materials. For 0.040 in. sheets, fully annealed, the tensile strength is 49,900 lb. per sq.in.; elongation, 64.5 per cent in 2 in., and Rockwell hardness, B25. The same sheet, heat-treated, after rolling six numbers hard, has the following properties: tensile strength, 128,000 lb. per sq.in.; elongation 11 per cent in 2 in., and Rockwell hardness of B104. The beryllium content was 1.5 per cent. With 2.5 per cent beryllium content and 0.063 in. sheet, heat-treated after rolling 1½ numbers hard, the sheet reached a tensile strength of 196,000 lb. per sq.in.; elongation 3 per cent in 2 in., and a Rockwell hardness of C42.

Machinability of the alloy compares favorably with that of other high strength metals. It cannot be classified as free cutting, but it is not difficult to machine. Welding must be done in a hydrogen atmosphere, but the material can be brazed, silver soldered or soft soldered almost as easily as pure copper. In appearance the beryllium copper closely resembles pure gold.

Prosser Z-Foil Process for Carbide Tools

Thomas Prosser & Son, 15 Gold St., New York, N. Y., and 1050 Mt. Elliott Ave., Detroit, Mich., have announced a patented brazing process known as the "Z-Foil" process, for attaching cemented carbide tips of various kinds to steel shanks. It is claimed that the process produces a bond between the cemented carbide and the steel shank several times stronger than produced by copper brazing. It is further stated that Widia tools can be supplied for severe service, brazed by the Z-Foil process, with the guarantee that tips will not come off.

No dovetailing of the tip is necessary. Therefore, the extra charge for unusable cemented carbide in dovetailed tools is eliminated. Tip cracking in service is also minimized since the Z-Foil bond absorbs stresses caused by the difference in coefficient of expansion between the Widia tip and the steel shank. It is also practical to braze to any type of steel, so that extra-hard or extra-tough shanks can be supplied. The cushioning effect of the bonding material helps absorb shocks in service. It is also said that heat generated in cutting is more rapidly dissipated into the shank so that the tip remains cooler, with consequent longer life between grinds.

Reinecker Worm Grinder

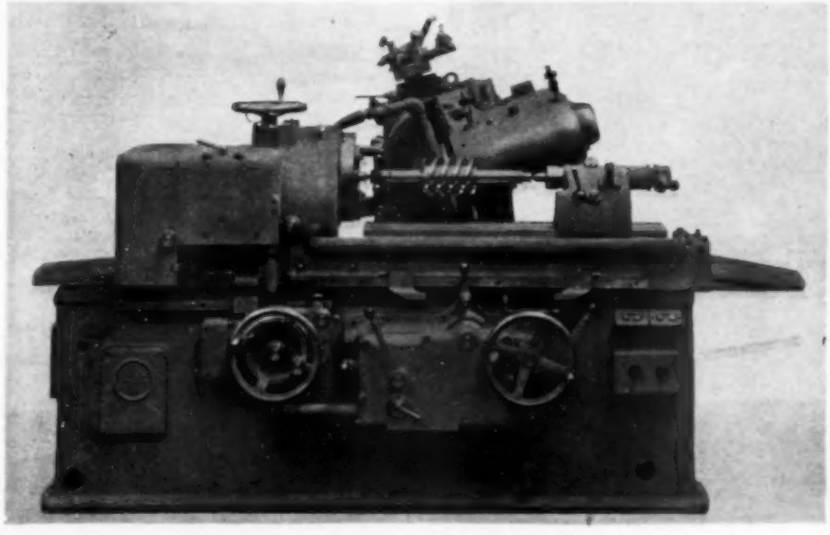
Leads from ⅛ to 25 in. can be taken care of by the Reinecker worm grinder introduced in the United States by the George Scherr Co., Inc., 128 Lafayette St., New York, N. Y. The machine can be quickly changed from one job to another without changing leadscrews. In order to cover the above range, two ratios are provided. Two ranges are ⅛ to 1 in., and ½ to 25 in. lead, both right and left hand. When grinding the fine threads the drive of the leadscrew is derived from the shaft driving the work piece in the manner of a lathe. Specifications are as follows: Maximum length between dead centers, 29½ in.; maximum grinding length without resetting, 24 in.; maximum diameter of work, 10½ in.; maximum collet diameter in hollow workhead spindle, 3 in.; number of table speeds, 6; wheelhead swivels to either side, 45 deg.; number of wheel speeds, 2; approximate weight without motors, 7,000 lb.

The machine will grind the flanks of hardened or soft worms, single or multiple thread, right- or left-hand lead. Worms are ground between dead centers up to 29½ in. in length. Longer worms integral with shafts on both ends can be passed through the hollow spindle and clamped by collets with split bushings. The greatest grinding length of worm in one operation without resetting is 24 in.

Grinding takes place in one direction. Double-bevel grinding wheels are used so that both flanks can be ground at the same time, except in case of very heavy pitches. After the wheel has passed through the thread, the table feed dwells an instant to allow the wheel to recede and clear the work. This motion is operated hydraulically. Thereafter the table reverses rapidly to the starting position, where the wheel again enters the thread for repeated grinding passes. Feed is by hand or automatic. The automatic feed may be set from 0.0001 in. to 0.002 in.

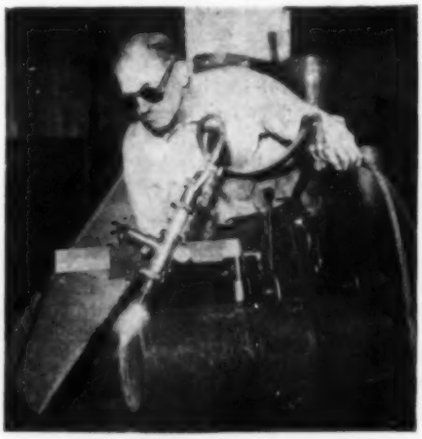
The indexing mechanism for multiple thread worms is fully automatic, and indexing takes place during the rapid return motion of the table. As soon as the different threads have been gone through once by the wheel, the automatic wheel feed sets in. It is also possible to actuate the feed motion after ¾, ⅘, ⅚ rotation by exchange of curved plates so as to distribute the wear of the wheel more evenly over all the threads and to result in a high degree of accuracy and uniformity of the different threads. A separate plate is required for every number of threads.

Gear box contains six speed changes, the automatic feed of the grinding wheel and the steering valve for the hydraulic quick-motion of the wheel carriage. Drive of the gear box is affected by a 4-hp. motor connected with texrope belts to the drive shaft for the gear box and oil pump for hydraulic feed. The wheel is driven by a 10-hp. motor. Grinding head may be swiveled 45 deg. either way, and thrust on the spindle is taken by adjustable ball bearings.



Airco No. 1 Portable Pipe Cutting and Beveling Machine

To cut off and bevel pipe to the desired welding angle, the No. 1 machine has been developed by the Air Reduction Sales Co., Lincoln Bldg., 42nd St. New York, N. Y. The machine comprises a light four-wheel carriage on which are mounted a crank-driven chain sprocket and a torch-supporting bracket. The carriage is held against the pipe by a roller chain surrounding the pipe and engaging the sprocket. When the sprocket is turned by a hand crank sufficient frictional grip on the pipe is



obtained to rotate the pipe when the latter is free to turn, or to rotate the machine itself around the pipe when the pipe is fixed in position. The machine cutting torch is adjustable on the bracket to any required bevel angle from the vertical to 45 deg. The torch may be adjusted laterally.

Cataract Six-Speed Motor Drive Unit

The Cataract six-speed motor drive unit, designed for use with bench lathes, hand screw machines and milling machines, has been developed by the Hardinge Bros., Inc., Elmira, N. Y. The design eliminates gears and clutches and by the use of endless belts prevents noise, chatter and vibration. Six forward and six reverse speeds are obtained by the application of a standard two-speed reversible motor. Motor speed changes are controlled by patented self-locking treadles. The unit comprises a bench, two-speed reversible motor, controls for motor, treadles, steel drawer, collet board, shelf for motor, drive shaft, endless belts and pulleys and other parts.

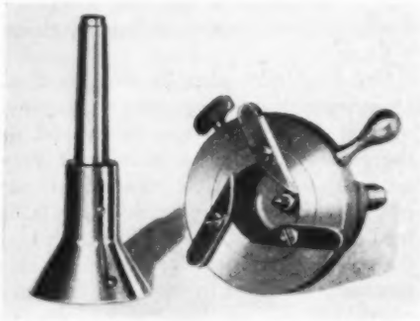
Millers Falls No. 461 High-Speed Portable Grinder

A totally inclosed motor is used in the 6-in. high-speed portable grinder announced by the Millers Falls Co., Greenfield, Mass. This No. 461 tool has the motor so shrouded that the fan-generated air passes entirely around the motor but not through it, thereby eliminating the entry of dirt and grit to the motor and bearings. The oversize ball bearings are of the improved grease-seal type. The heavy-duty switch, rated at 30 amp. at 250 volts, is totally inclosed. Gears are of chrome-nickel steel, heat-treated. No-load spindle speed is 5,500 r.p.m., and bakelite or rubber bonded wheels, designed for high-speed operation, must be used. The tool can be externally lubricated at both ends without disassembling. It weighs 24 lb.

Carroll Self-Centering Device for Lathes

All sizes from 0 to 2 in. can be centered with the self-centering device built for lathes by Wm. Carroll & Son, 1776 Lexington Ave. (Norwood), Cincinnati, Ohio. The driver has a No. 3 Morse taper and fits in the lathe spindle, and the centering device has a No. 3 Morse taper and fits in tailstock. The device can be furnished, however, in any size taper desired. Center drill furnished is 30x30 but by removing the bushing, the larger center drill 13x13 can be used. Center drills are of standard sizes and can be purchased anywhere.

The device rotates the work and supports it in a 3-point center rest. It is claimed that the device gives accuracy required on finished work and on shafts and similar work that require a precision grinding job. Weight of the device is 14 lb.

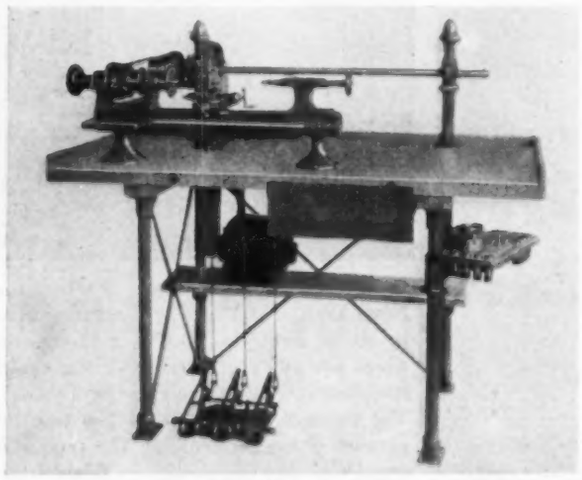


Thor Drill and Reamer

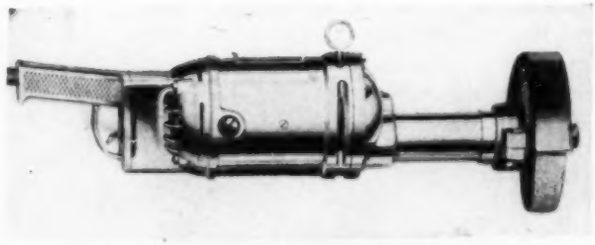
The Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., has designed a drill and reamer in which the offset motor is separate from the frame and feed screw post. This design makes for a short, sturdy machine and permits the use of a feed of greater range. It also permits the use of a short spindle, which is necessary when operating in close quarters. The switch handle is of the safety-roll type and cannot be operated except by a turn of the operator's hand. The switch handle is similar in appearance to the throttle used on pneumatic drills and has no openings to permit dust or dirt to enter. A grip handle can be supplied in place of the feed screw. The drill and reamer is made in five sizes, the drilling capacities ranging from $\frac{7}{8}$ to $1\frac{3}{4}$ in., and reaming capacities from $\frac{11}{16}$ to $1\frac{1}{8}$ in.

Lemag Torsiograph and Vibrograph

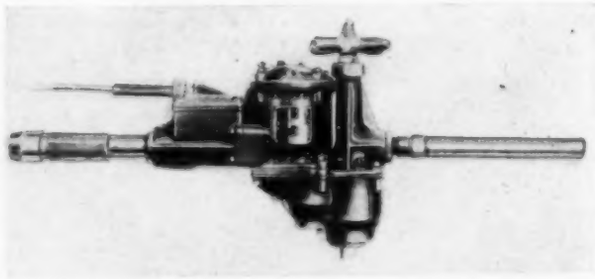
A Lemag universal measuring instrument, of which the Vibrograph and the Torsiograph are examples, is being introduced in the United States by the Baldwin-Southwark Corp., Southwark Foundry & Machine Co. Division, Philadelphia, Pa. The instrument consists essentially of three parts: the registering apparatus, the transmitting apparatus and the disturbance-receiving ap-



Cataract Bench Lathe with six-speed motor drive unit that eliminates vibration



Millers Falls No. 461 High-Speed Grinder



Thor Drill and Reamer

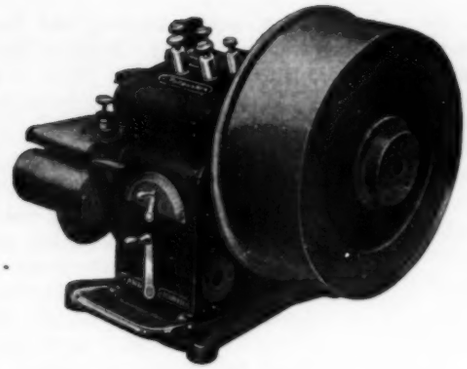


Fig. 1—Lemag Normal Torsiograph for registering all torsional fluctuations from 300 to 6,500 per minute

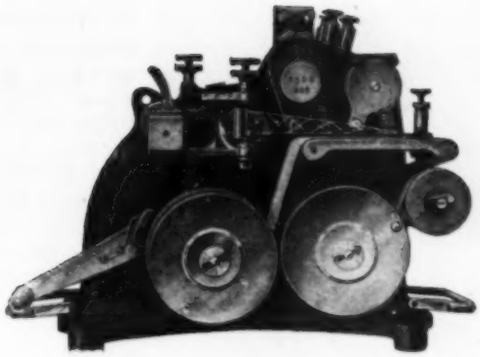


Fig. 2—Lemag Universal Vibrograph for vibrations ranging from 1 per second to 700 per second

paratus. Only the latter is variable among the numerous adaptations. Among the services to which the instrument can be adapted are: measurement of torsional vibration, or non-uniform angular velocity; recording of bending and deflectional oscillations, impacts, pressure actions, and relative motions of all kinds; static and dynamic elongations and stresses in machines.

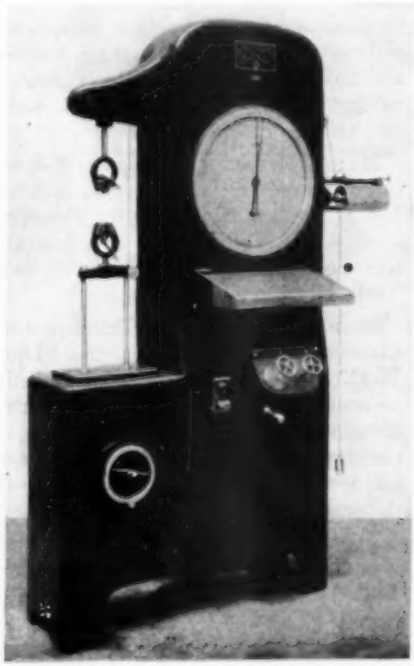
The Torsiograph is used for studying, measuring and registering the phenomena in revolving shafts, such as torsional vibrations, critical speed, oscillations, angular deviation, torsional stresses, degree of irregularity of speed. The transmission member in this case consists of a light aluminum belt pulley, which is driven in synchronism from the shaft to be investigated by a non-elastic special band. Inside the pulley is an annular flywheel connected to the belt pulley by a spiral spring elastically, in such a way that it revolves uniformly owing to its inertia. The relative motions between the belt pulley and the inert mass correspond to the absolute fluctuations of rotation and by means of transmission levers, they are transmitted and recorded through the hollow spindle of the apparatus on a recording lever of very small mass. The normal Torsiograph, Fig. 1, serves for registering all torsional fluctuations from 300 to 6,500 per minute.

The Vibrograph serves for measuring and registering vibrations and oscillations of all kinds from the lowest to the highest frequencies in horizontal and vertical directions or at any angle. The transmitting device differs from that of the Torsiograph, inasmuch as the circular flywheel is replaced by a segmental mass, and by the fact that the pulley is fixed by a clamping band. The normal Vibrograph records all oscillations and vibrations from 300 to 20,000 per minute. The universal Vibrograph has a range of vibrations from 1 per second to 700 per second.

Olsen Hydraulic Universal Testing Machine

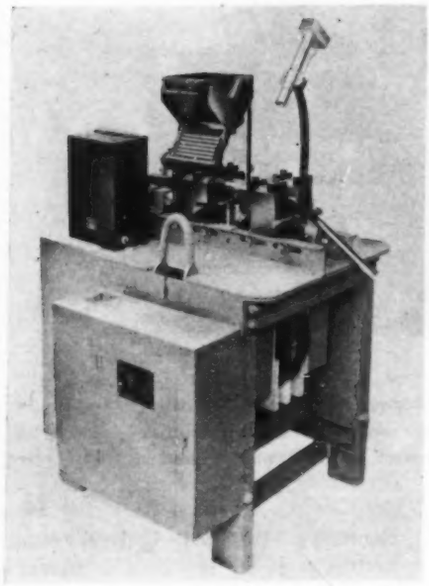
Designed primarily to test fine wire and strip steel, the hydraulic universal testing machine illustrated has been placed on the market by the Tinius Olsen Testing Machine Co., 500 North 12th St., Philadelphia, Pa. This machine is supplied with a self-indicating pendulum dial, a lever weighing system and a No. 3 recorder. Capacities range from 1,000 to 5,000 lb. The standard machine is furnished with dual capacity. A machine of 2,000-lb. capacity arranged for the full range will give readings at 2-lb. intervals; same machine set for 100-lb. range gives readings to 1/10 lb. This gives a high degree of accuracy on light test loads.

Loading may be accomplished either hydraulically, as illustrated, or mechanically. Where the hydraulic loading system is used, provision is made for constant speed of testing, regardless of load, up to the capacity of the machine. One handwheel may be set for any predetermined speed of testing, and remain at that setting during the range of tests. Variations in speed from this point may be accomplished by use of the secondary handwheel, without disturbing the original setting of the first. Return of the pulling head after rupture of the specimen is quickly accomplished and the head automatically returns to its initial position, ready for the next test. Clearance between grips of 0 to 10 in. may be secured by adjustment through the handwheel at the lower left-hand side of the machine. Travel of the pulling head in the hydraulic machine is 4 in. The pointer of the pendulum dial makes two revolutions to the indicated capacity in order to give greater accuracy and sensitivity.



A.C.F. Berwick Electric Metal Heaters

Temperature controlling devices making it impossible for the operator to overheat the material are now fitted to the Berwick electric metal heaters built by the American Car & Foundry Co., 30 Church St., New York, N. Y. Heaters are made for all kinds of forging work up to 2 in. cross-sectional area, and the temperature will not vary 20 deg. from that for which the electric eye (photo-electric control) is set. Illustration shows a forging heater for heating any diameter stock from 3/8 in. up to 2 in., where the stock is cut to any length from 3 in. up to 12 in. The temperature of the piece is gaged by the setting of the electric eye, and the pieces piled in the hopper are heated to the desired length, to the desired temperature, and are delivered to the operator



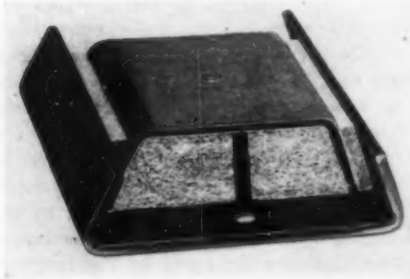
at the upsetting machine, with no attention from the operator except to keep the hopper filled. The heater can be built with from 1 to 5 electrodes to give desired hourly capacity. The electrical consumption averages 18 kw.-hr. per 100 lb. of metal heated, not of the total weight of the piece.

A rivet heater is also available for sizes up to and including $\frac{5}{8}$ in. in diameter, or pieces of steel of a similar nature, from $\frac{1}{2}$ in. in length up to 3 in. or longer. The demand is from 2 to 5 kw.

Korfund Seismo-Damper

Isolation of machines, which because of their light weight cannot be conveniently isolated with natural cork plates or where Vibro-Dampers are not warranted, can be undertaken with the Seismo-Damper developed by Korfund Co., Inc., 48-15 32nd Place, Long Island City, N. Y. The isolating material (natural cork or other resilient material), is placed between an upper and lower housing and preloaded to that point which compensates for the difference between the loading established by the operating machine and the peak efficiency loading required by the isolating material. The upper housing of the damper is drilled and tapped to permit bolting to the machine base or leg. The lower housing is drilled for two $\frac{3}{8}$ in. bolts for anchoring to the floor. The maximum load per damper is 400 lb.

Spring bases, also recently developed, consist of sensitive double-acting spring chairs that are used to support resiliently the machine platform.



TRADE PUBLICATIONS

CHAIN. The Morse Chain Co., Ithaca, N. Y., is distributing Bulletin No. 51 on the Morse roller chain drives, mentioning the design features of the chain which is made in standard sizes from $\frac{3}{8}$ to 2 in. pitch and giving complete data on the chain and prices, together with information on various types of sprockets, both stock and non-stock types. Information is also included on how to design roller chain drives.

GRINDING MACHINE. The Abrasive Machine Tool Co., East Providence, R. I., has issued a folder on its No. $1\frac{1}{2}$ surface grinder described recently. Suggested uses of the machine are treated pictorially.

ILLUMINATION. The New Jersey Zinc Sales Co., 160 Front St., New York, N. Y., has prepared a non-technical discussion of "Using Paint as Light" which shows by means of charts the amount of illumination on the working plane with different types of illuminating fixtures and how the intensity of light is affected by the color of paint used on the walls and ceiling.

MONEL METAL. "Engineering Properties of Monel Metal," known as Bulletin T-5, is now available from the Development & Research Dept., The International Nickel Co., Inc., 67 Wall St., New York, N. Y.

MOTORS. The Lincoln Electric Co., Cleveland, Ohio, describes the "Linc-Weld" Type D Motor in a bulletin known as "That Motor with the Extra Horsepower." Construction details of the frame, stator, rotor, bearings and end brackets are included, together with dimensions.

MOTORS. Reliance Electric & Engineering Co., Cleveland, Ohio, has issued Bulletin No. 114 entitled "Low-Inertia Special-Torque A.C. Motors," the motors being designed for quick acceleration, quick stopping, and frequent and rapid reversing. Bulletin No. 116 is entitled "Form 0SH Type AA Reliance Motors," the motors being for flywheel application.

NICKEL CAST IRON. The International Nickel Co., Inc., 67 Wall St., New York, N. Y., has published the first of a series of tabulations on nickel and nickel-chromium cast-iron compositions entitled "Guide to the Selection of Engineering Specifications for Grey Cast Iron." The leaflet gives special attention to sections of various dimensions. Specifications for machine tool frames, spindles for vertical turret lathes, and hydraulic press cylinders will be found, for example.

PUMPS. DeLaval Steam Turbine Co., Trenton, N. J., has published Catalog L-10 on "Imo Oil Pumps" designed to run at standard motor speeds. The catalog lists pumps for capacities ranging from 4 to 460 gal. per min., and for pressures up to 200 lb.

QUARTER TURN DRIVES. Bulletin No. 3970, issued by the Gates Rubber Co., Denver, Colo., gives engineering data on the Gates "Vulco" quarter turn drives, including horsepower tables.

SANDBLAST HELMETS. Bulletin No. 193, issued by the Pangborn Corp., Hagerstown, Md., describes the Type DF blast helmet and other types for use by sandblast operators. Construction of the helmet is completely described.

STAINLESS CLAD STEEL. The Ingersoll Steel & Disc Co., division of Borg-Warner Corp., 310 S. Michigan Ave., Chicago, Ill., has issued a folder describing the composition, method of manufacture and fabrication of Ingersoll stainless-clad steel, as well as illustrating and listing many applications.

STEEL CASTINGS. Ten extensive technical papers comprise the "Symposium on Steel Castings" published jointly by the American Foundrymen's Association and the American Society for Testing Materials. Carbon-steel and alloy-steel castings are covered. Extensive oral and written discussion of the papers is included. The symposium involves 254 6x9 in. pages, bound in a heavy paper cover. Copies are obtainable for $1.00 each from the American Society for Testing Materials, 13 Spruce St., Philadelphia, Pa., or from the American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

TILTABLE ROTARY TABLES. Pamphlet No. 556, distributed by R. Y. Ferner Co., Investment Bldg., Washington, D. C., describes three sizes of circular tables designed for use on Swiss jig borers. The tables can be tilted through any angle up to 90 deg.

• One of the most significant advances of recent years has been the development of machine forging. In our first article Fred Colvin reports the results of a recent study undertaken to bring the information on this art up to date. He had the cooperation of important makers and users of forging machines and the article is correspondingly authoritative.

• Something new in metal cutting is the feature of the two-part article by H. H. Moss of Linde Air Products Co., the first installment of which is printed in this number. The author reviews the general subject of flame cutting and then takes up the new application which directs the oxyacetylene flame tangentially toward the work instead of perpendicularly. He includes figures on gas consumption and relative accuracy, and shows a table of the various types of flame cutting that are now possible.

• Many are the production men who have cursed an engineer for setting limits that made the shop problem needlessly difficult, and many are the managers who have had unpleasant shocks when they saw the costs resulting from such errors. E. Chat. Shanks discusses this very common problem and offers remedies based on experience.

• A modern production line planned to handle circuit breakers of many different sizes is operating at the Mansfield Works of Westinghouse E.&M. C. M. Richardson, of Westinghouse, tells how the plan was worked out and how the "De-Ion" breakers are produced.

• Contributory infringement sounds dangerous, and it is dangerous for the unwary manufacturer. H. A. Toulmin, Jr., prominent patent attorney, explains why the manufacturer of a part or subassembly is guilty if that unit becomes part of any machine that infringes a patent.

• O. A. Johnson's tenth article on forming tools takes up the details of proper mounting and grinding of these tools. Mr. Johnson, you will remember, is chief tool designer of Tyson Roller Bearing Corporation.

• In this Round Table, Al is looking for the perfect mechanic. Ed insists that even the best of us may make occasional slips, but Al is obdurate. Is there such an animal?

◆

• AMERICAN MACHINIST •

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*
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Coming

JANUARY 1933 will be the first month of a year of better times, we all hope. Of our two issues in January the first will contain the concluding article in the Johnson series on forming tools, and the conclusion of the Moss article on machining with oxyacetylene. The latter article shows some of the remarkable turning, threading and billet-seaming jobs that can be done with the gas torch. There is also an article by John Haydock, based on the Product Engineering survey of product development activity, pointing out markets for equipment and discussing the responsibility of the production men in developing them. The other January issue will be the Twentieth Shop Equipment Review. It will carry reviews of the new equipment that is ready to the hand of every shop and plant manager who wants to rehabilitate.

NEW PRODUCTS

bring new problems and new opportunities to production men

A FEW WEEKS AGO, our companion publication. Product Engineering, received written reports from subscribers in 430 plants, describing what they are doing now in product development. The men who reported are responsible for product engineering and design in large and medium-size companies all over the country, which manufacture machinery and engineered metal products of all kinds,—from instruments to steam shovels.

See what these 430 companies are doing:

1933 ACTIVITY IN PRODUCT DEVELOPMENT

(Among 430 Companies)

	Number	Per Cent
Companies continuing present activity undiminished	285	66
Companies planning increased product development programs	98	23
Total	383	89

ACTIVITY IN NEW PRODUCTS

(Among 430 Companies)

	Companies
Developing *new* products in *present* line	330
Developing *new* products in a *new* line	128

(Some companies are of course doing both)

The next table shows the five important general objectives at which product engineers are directing their creative engineering effort:

GENERAL CHARACTER OF PRODUCT DEVELOPMENT

(Among 430 Companies)

	Companies
Design for higher price class	89
Design for lower price class	212
Reduced cost of manufacturing	221
Greater number of styles	154
Design to increase the range of use of the product	189

The 430 manufacturers further stated the specific improvements through which their product development programs aim to increase sales:

DESIGN FACTORS EMPHASIZED

(By 430 Companies)

	Companies
Higher speeds	170
Larger and heavier units	78
More automatic operations	147
Greater precision in use	158
Decreased power consumption	120
Improved gearing	101
Better electrical control	136
Better springs	29
Devices to minimize vibration	137
Better lubrication	181
Adoption of corrosion-resisting materials	207
Improved lock washers and locking devices	116
Closer manufacturing tolerances	156
More easily replaceable units	189
Restyling to give new form	179
Better surface finish	149
Improved color schemes	47
Materials adopted for improved appearance	141

Revealing their plans in still further detail, many of them stated the actual new parts and materials which they will probably incorporate in their improved designs:

MATERIALS, CONSTRUCTIONS, PARTS AND FINISHES WHOSE ADOPTION IS BEING CONTEMPLATED

(By 170 Companies)

Materials

	Companies
Alloy cast iron	24
Alloy steels	16
Malleable iron	12
Stainless steels	36
Aluminum or its alloys	32
Copper-nickel alloys	5
Magnesium alloys	23
Copper, brass, and bronze	27
Fibre	10
Rubber	15
Cork	10
Porcelain	7
Wood, plywood, pressed wood, etc.	4

Construction

Steel castings	11
Forgings	17
Die-castings (zinc or aluminum alloys)	26
Pressed metal parts	21
Rolled, drawn, or extruded shapes	23
Welded construction	20
Molded parts	17

Parts and Units

Ball or roller bearings	17
Electric motor drive	11
Gasoline engine drive	4
Clutches	8
Flexible couplings	8
Universal joints	6
V-belts	16
Silent chain or roller chain	14
Flexible shafting	10
Speed reducers	10
Variable-speed transmissions	11
Pumps and controls for hydraulic operation	17
Self-lubricating bearings	12
Gun-type lubrication	7
Central lubricating system	18
Oil filters	12
Electric heating units	11
Auxiliary control apparatus (indicating, recording, regulating, timing, counting, etc.)	15
Lacquer, varnish, or Japan finishes	12
Porcelain enamel finish	7
Chromium, cadmium, nickel, and other plating	48

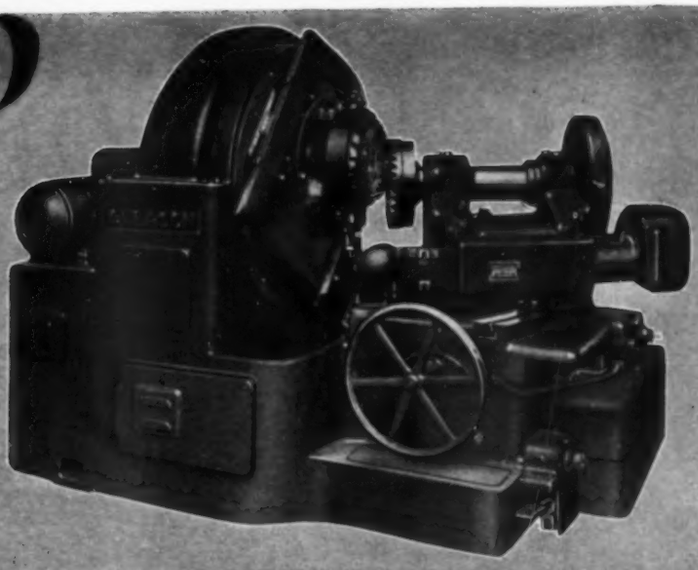
NEVER before have conditions compelled so great an attention to product development. As this report strikingly shows, many new lines are being created and old ones improved, with greater values in serviceability, durability, and beauty.

Every design change revealed in these figures, involves some change in manufacturing equipment or process. In the great amount of necessary retooling, buying of new machines and accessories, as well as shifting and remodeling of existing equipment, the production man has a great responsibility.

American Machinist will of course continue to report and interpret the most modern and efficient equipment and methods, in its articles and advertisements.

American Machinist

ACCEPTED



SPIRAL Bevel Gears, with curved teeth, have been universally adopted by the automobile manufacturers, also by many others. They have been accepted by designers and manufacturers because they are best.

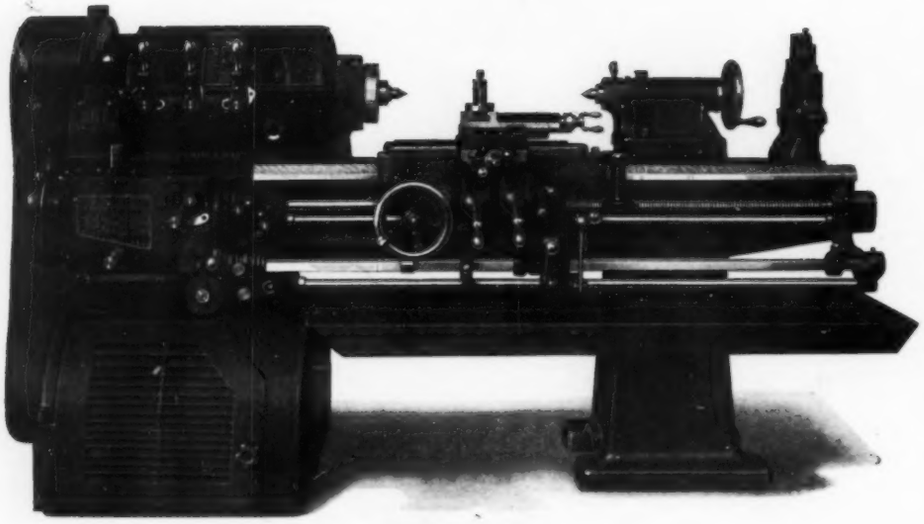
Investigate our entirely new line of equipment for producing spiral bevel gears, ranging in size from 1/4" to 90" pitch diameter.

The new No. 16 Spiral Bevel Gear Generator is just one of our many new machines. It has a capacity for cutting up to 10 to 1 ratio, 1-3/4" face, 2-1/2 diametral pitch and has a feed range (time per tooth) of from 12 to 73 seconds.

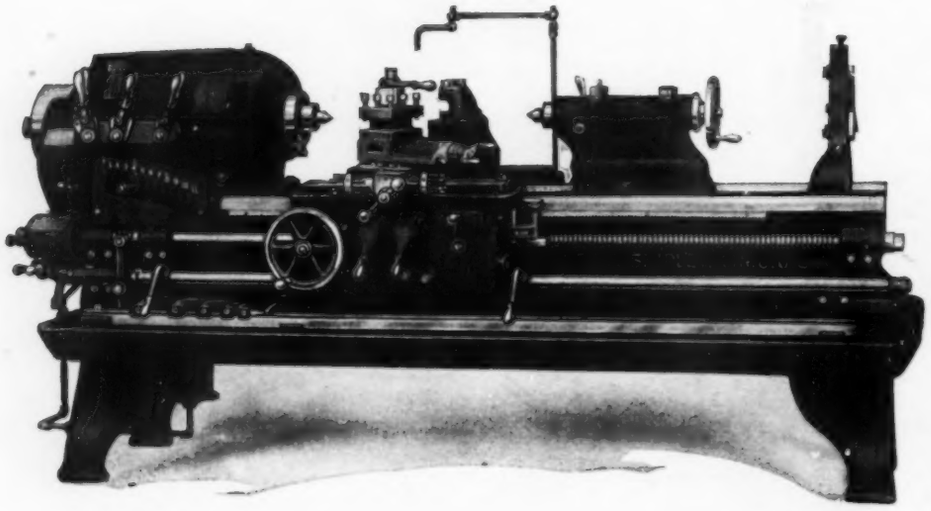
Write for engineering data on the gears and descriptive literature on the machines.

GLEASON WORKS, ROCHESTER, N.Y., U.S.A.

One piece or there is a



THE ENGINE LATHE—Lodge & Shipley Engine Lathes have gained a wide acceptance through the ability to maintain close tolerances on different lathe work and by the economies effected through their many exclusive features. Lodge & Shipley Lathes are manufactured in sizes from 12″ to 60″, details of any of which will be sent on request.



THE MANUFACTURING LATHE is basically an engine lathe equipped with a number of attachments that adapt it for production work. The front and rear tooling is accurately controlled by Multiple Length and Diameter Stops, making the machine particularly efficient on work having numerous shoulders and varying diameters. Sizes from 12″ to 36″.

THE LODGE & SHIPLEY

CINCINNATI,

1000

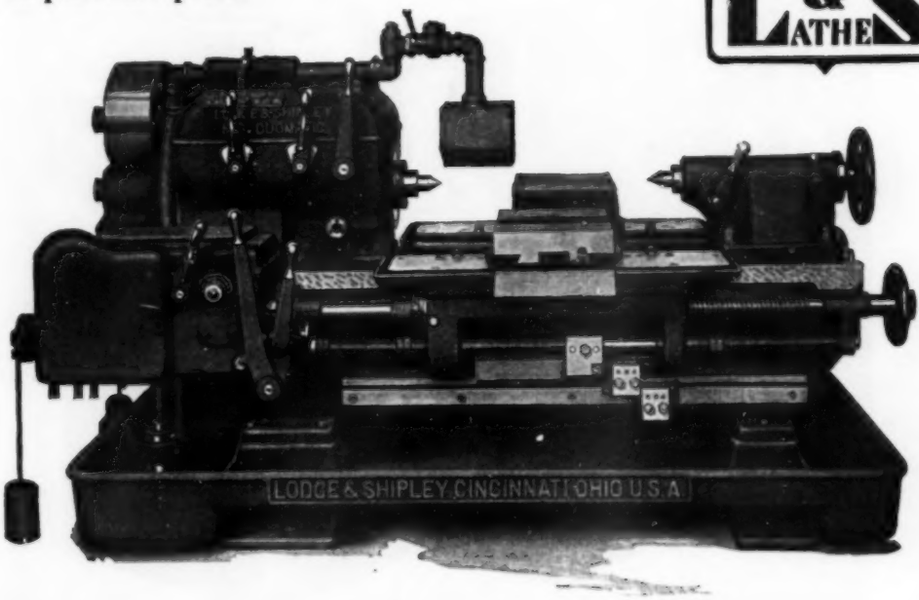
Lodge & Shipley Lathe for the purpose

Regardless of what your production needs may be there is a machine in the Lodge & Shipley Line to fill them.

The Lodge & Shipley ever reliable Engine Lathe has proved a dependable standby for single piece work. The Manufacturing Lathe, semi-automatic in operation, combines the ability for production of duplicate pieces without hampering its utility for single piece work. The Duomatic is a fully automatic lathe for the advantageous use of multiple tooling to the limit of its possibilities.

A representative will be glad to call and explain why Lodge & Shipley Lathes represent the greatest value per dollar of purchase price.

L & S LATHES

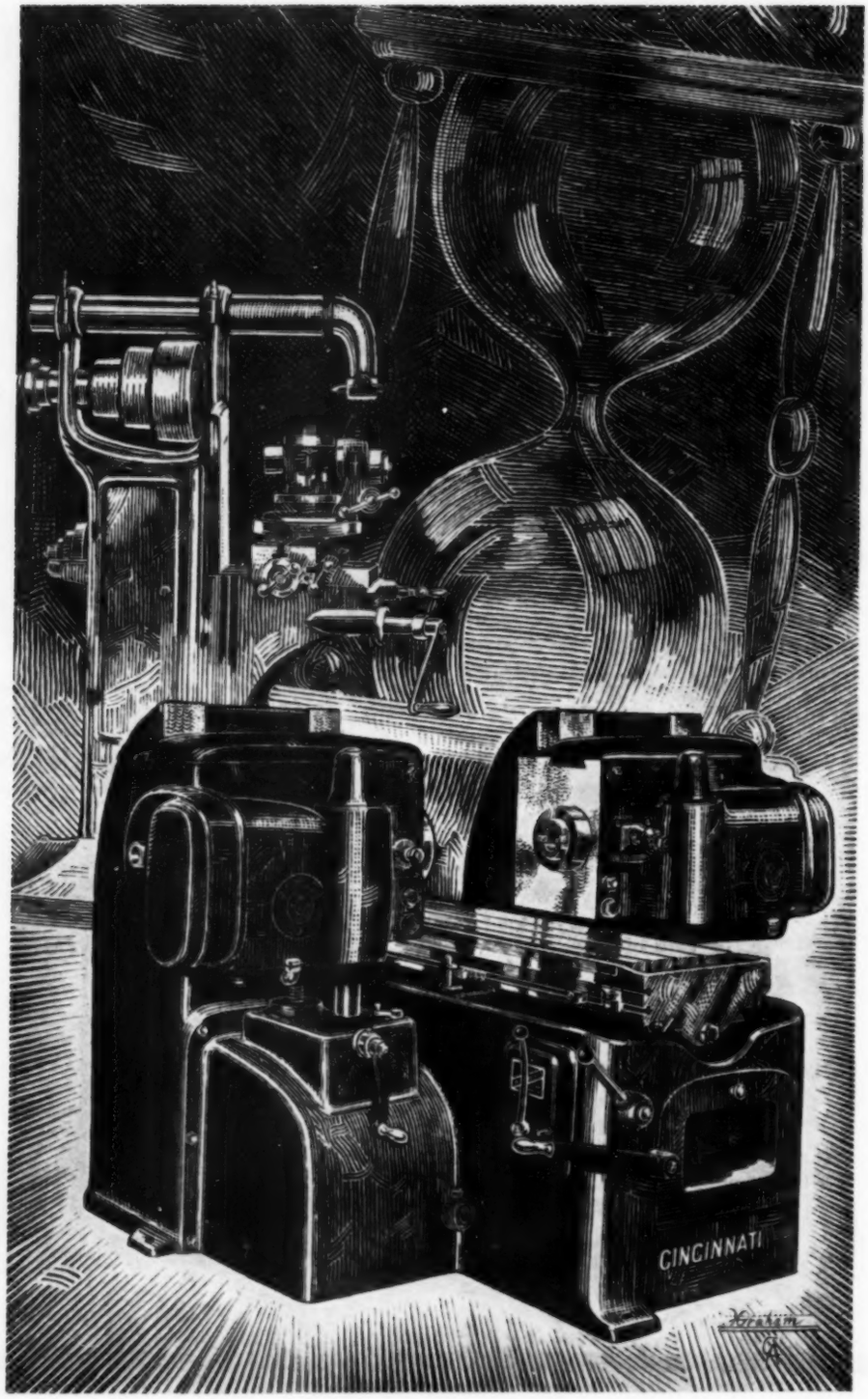


THE DUOMATIC is a fully automatic lathe. It has two complete carriages with tool slides. Each carriage and tool slide is equipped with power rapid traverse to the feed and return to the starting point. Each carriage is independently controlled and travels in a completely automatic cycle, including the locating of lengths and diameters on the work piece.

MACHINE TOOL CO.

OHIO, U. S. A.

THE YEAR



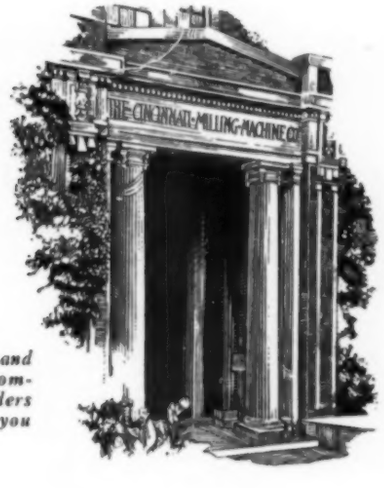
It's a long road that design has travelled since we first entered the automotive milling machine field. Today's Hydromatic Miller makes possible new economies in your shop for 1933 and thereafter.

CINCINNATI

TO COME···

Another year of experience is behind us! We believe that in the coming year we can give to you even better "Dependable Counsel on Milling and Grinding" . . . authoritative advice . . . that will help you get the most from your present machines and advantageously select new equipment. As you consider your part in the rehabilitation program, please know that we are ready to assist you.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO, U. S. A.



Plan to visit our plant and that of our associated company, Cincinnati Grinders Incorporated, when you are in Cincinnati.

THE J&L TANGENT DIE

J & L Tangent Dies are not only hardened throughout and ground on all working surfaces, but they are a masterpiece of the most accurate tool making craftsmanship.

Every detail of construction was worked out carefully to assure clean cut accurate threads, repeatedly after each resharpening. This is possible because the principle of holding the chasers guarantees accurate and positive location in the die.

JONES & LAMSON

Springfield,

WITH CHASERS GROUND IN THE THREAD

J & L Tangent chasers are ground in the thread and with the correct helix angle for each diameter and pitch. This assures a perfect thread form and the best possible lead on threaded parts produced by them.

J & L furnishes complete grinding equipment and measuring gages so that good performance can be duplicated repeatedly.

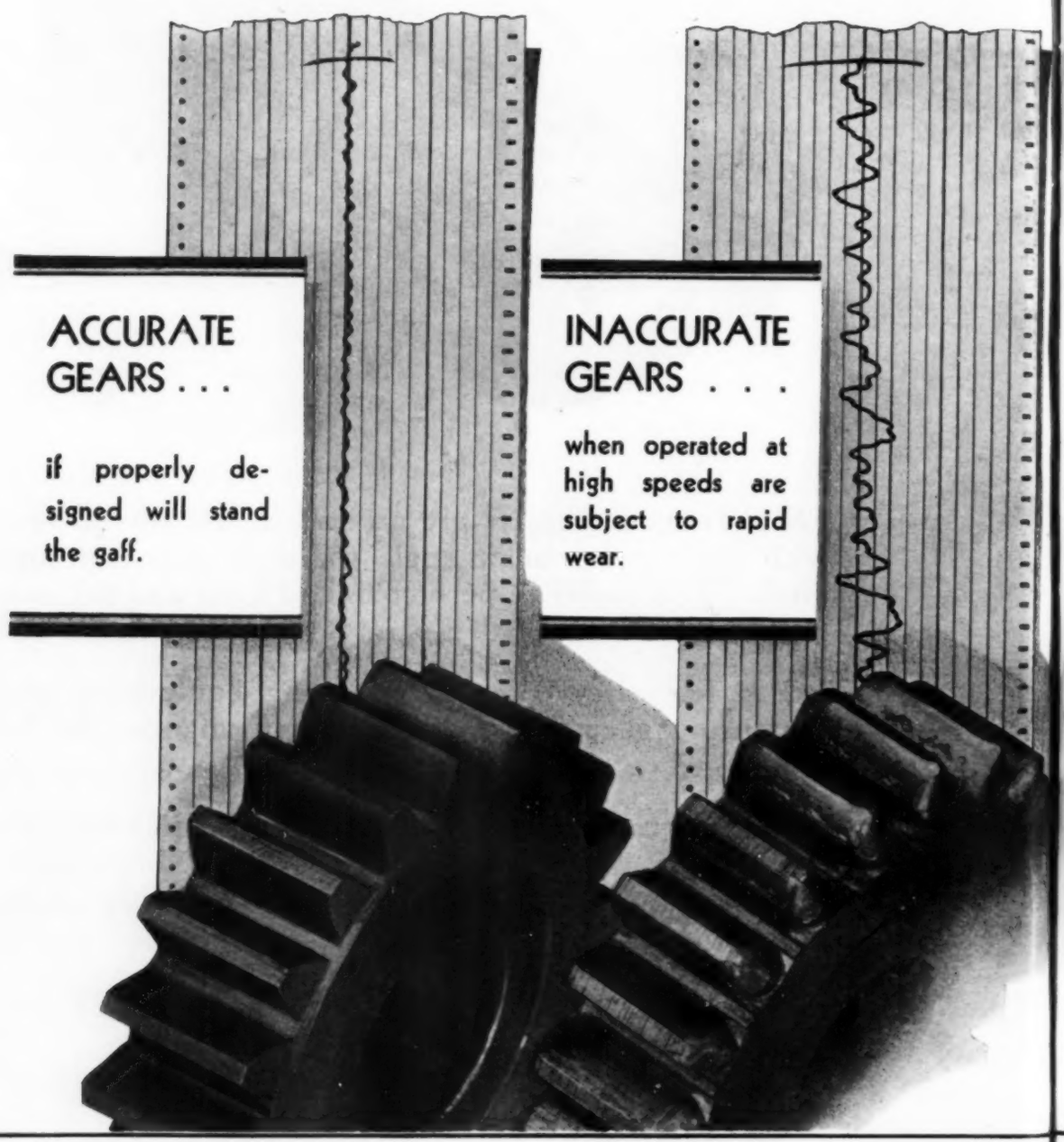
If you are troubled with threading problems on long runs, tough materials or inaccuracy, we will be glad to demonstrate the J&L Tangent Die in your shop under your own conditions.

MACHINE COMPANY

Vermont

What's it worth t

y


ACCURATE GEARS . . .
if properly designed will stand the gaff.
INACCURATE GEARS . . .
when operated at high speeds are subject to rapid wear.

Yo
wh
tio
. .

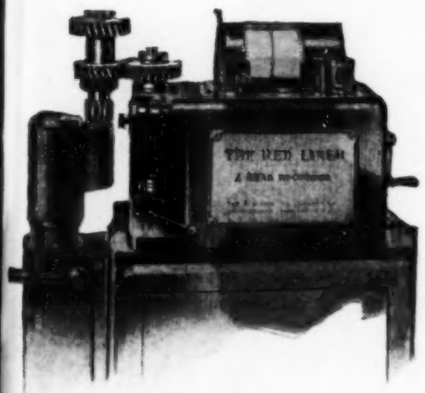
h to KNOW your gears will stand the gaff?

Gears which are designed for high speed operation **must be accurate,** not necessarily to reduce noise (although accuracy is conducive to quiet operation), but more especially to assure durability.

Wear becomes excessive (granting the use of proper design, materials, heat treatment, mounting, lubrication, etc.), when the teeth are inaccurately cut or distort in heat treatment. The cumulative sum of individual errors in the teeth, such as are shown on the **RED LINER** chart, may impose a load on the teeth much in excess of the calculated load, thus causing rapid pitting*, as shown, and a rapid breaking down of the tooth surface.

The safety limit for cumulative errors, determined by speed, pitch, load, material, etc., is of vital importance in the production of efficient and durable gears. Knowing this limit, as the result of performance tests, the **RED LINER** will tell you at a glance just when your gears are reaching the border line of safety.

The **RED LINER** functions as an insurance protection of your reputation as a manufacturer of high-quality gears. Compared with the satisfaction and advantage of KNOWING that your gears will stand the gaff, the cost of **RED LINER** inspection is trifling. Ask us to quote on the cost of placing one or more of these inspection machines in your gear department.



Your Inspection Routine is where your product's reputation for service ability is made . . . or lost.

** Note: Pitting is a condition in gearing which indicates excessive tooth loading. Excessive loading may be caused either by improper design, such as insufficient tooth surface to carry the load, or by impact loads in excess of the calculated loads that result from inaccuracies in the gear teeth.*

THE FELLOWS GEAR SHAPER COMPANY, Springfield, Vt.,
— or 616 Fisher Bldg., Detroit, Michigan

The Fellows line includes: GEAR SHAPERS AND GEAR SHAPER CUTTERS, THREAD GENERATORS, HELICAL CUTTER SHARPENING MACHINE, RED LINER, GEAR MEASURING MACHINE, AND GEAR AND WORM LAPPING MACHINES.

FELLOWS
~ GEAR SHAPERS ~
AND "RED LINER" INSPECTION

You, too,

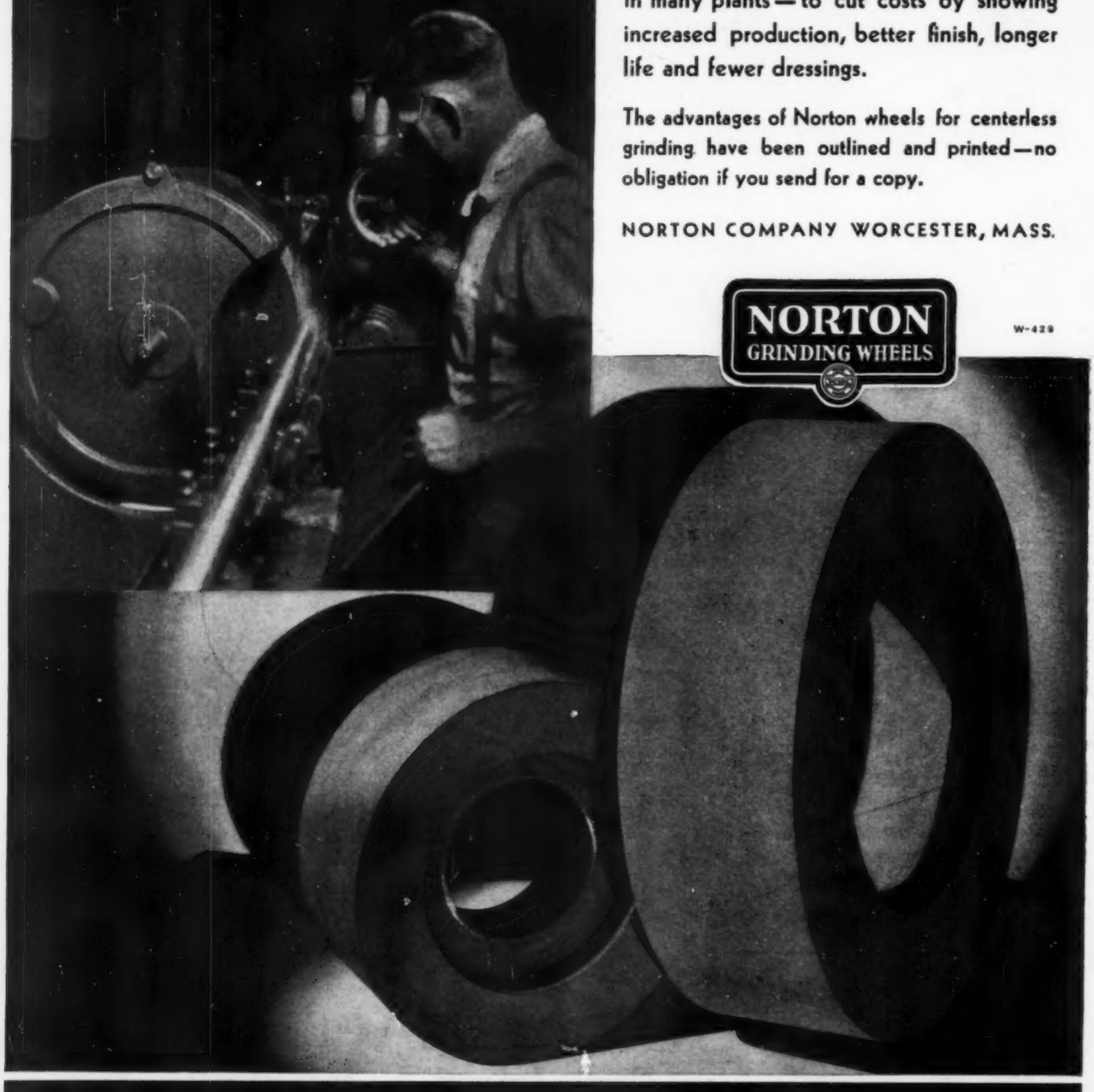
Can Cut Centerless Grinding Costs...

Controlled Structure and "B" Bond are doing it for many concerns.

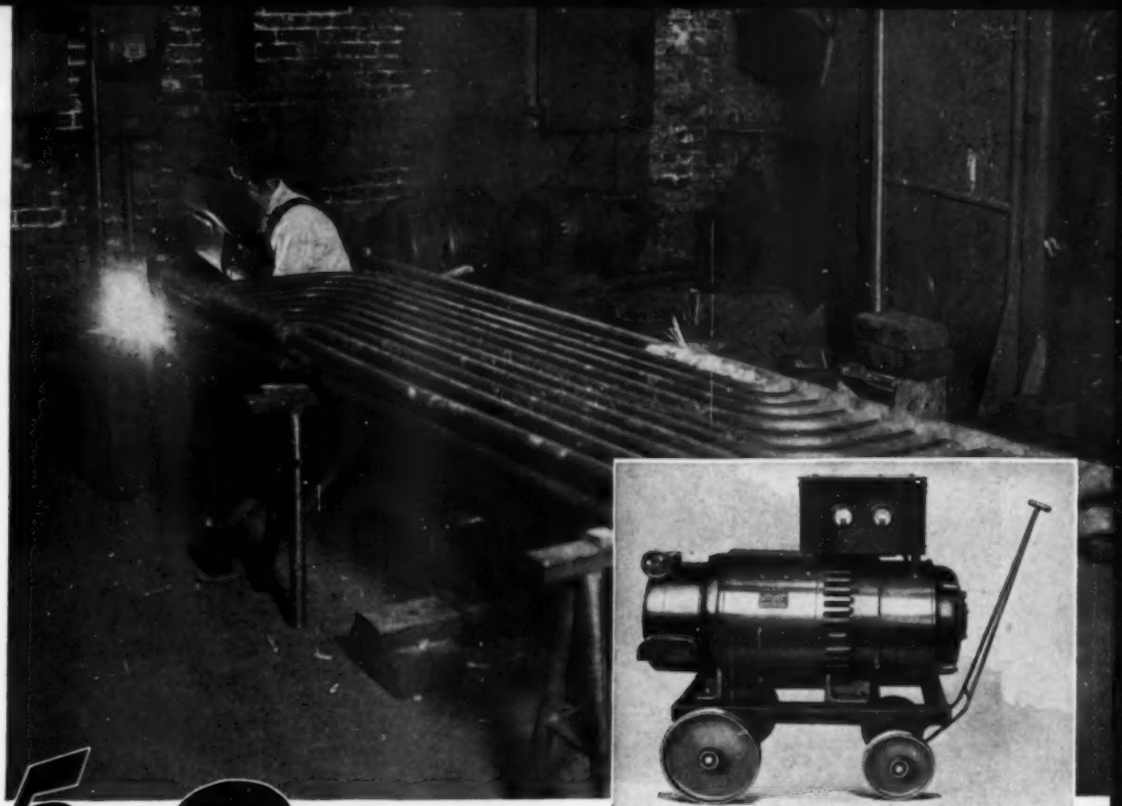
These two exclusive features are enabling Norton wheels to establish new records in many plants — to cut costs by showing increased production, better finish, longer life and fewer dressings.

The advantages of Norton wheels for centerless grinding have been outlined and printed — no obligation if you send for a copy.

NORTON COMPANY WORCESTER, MASS.



W-429



THE MODERNIZED P & H-HANSEN

No Exciter to Get Out of Order

Excitation of field coils is accomplished by two small auxiliary brushes. In the ordinary welding unit, excitation is accomplished by means of a separate small generator coupled direct to the main generator shaft and bolted to the generator housing. In the modern P & H-Hansen, however, the exciting current is provided by auxiliary brushes placed somewhat in advance of the main brushes. This unique and proved method of exciting the field coils eliminates a piece of trouble-making equipment and aids in reducing weight and increasing compactness.

P&H-Hansen Arc Welders are available in both motor driven and gasoline engine driven types and in sizes ranging from 100 to 800 amps.

5 to 20% Higher Efficiency *with* *America's Finest, Fastest Welder* Means Lower Cost Welding For You

Actual laboratory tests prove that the P&H-Hansen Arc Welder is 5 to 20% more efficient in its conversion of current into welding heat. That means lower power costs, plus a more easily controlled, hotter arc, and higher production.

This great advantage in efficiency is due primarily to the patented winding utilized only on this unit—America's finest, fastest welder. 100% of the energy generated is delivered at the arc—none is wasted in stabilizing. And you'll find that the modern P&H-Hansen is lighter, more compact, less susceptible to trouble than other welders. There are no bothersome "gadgets" on the P & H-Hansen.

P&H-HANSEN ARC WELDER

AMERICA'S FINEST FASTEST WELDER

Harnischfeger Corporation, Established 188
4514 West National Ave., Milwaukee, Wis
"Weld It Well"—Get your copy today. It'
full of facts for the welding engineer.

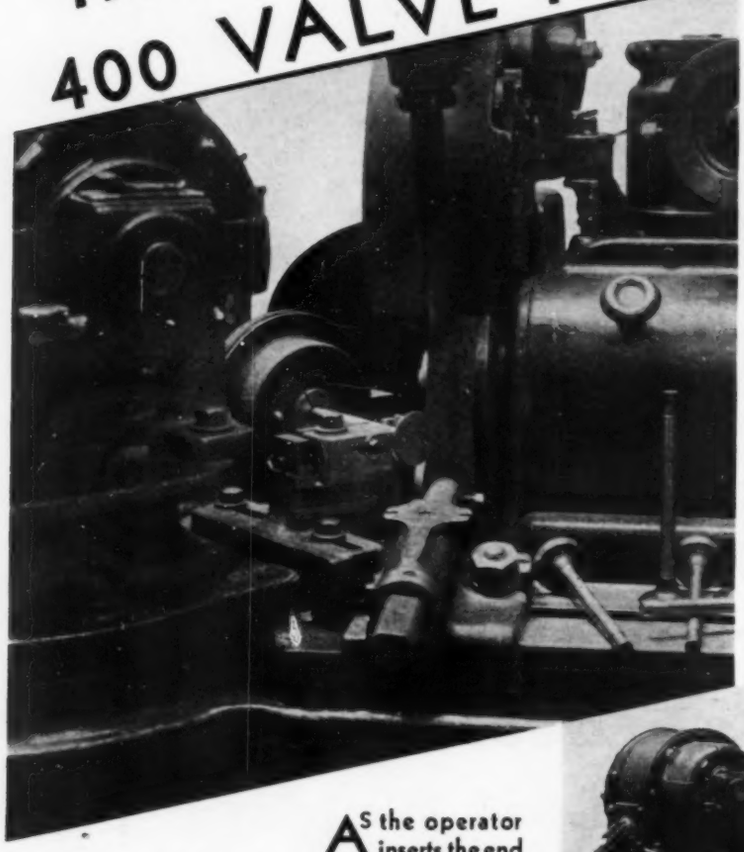
Name .....

Company .....

Address .....

City ..... State .....

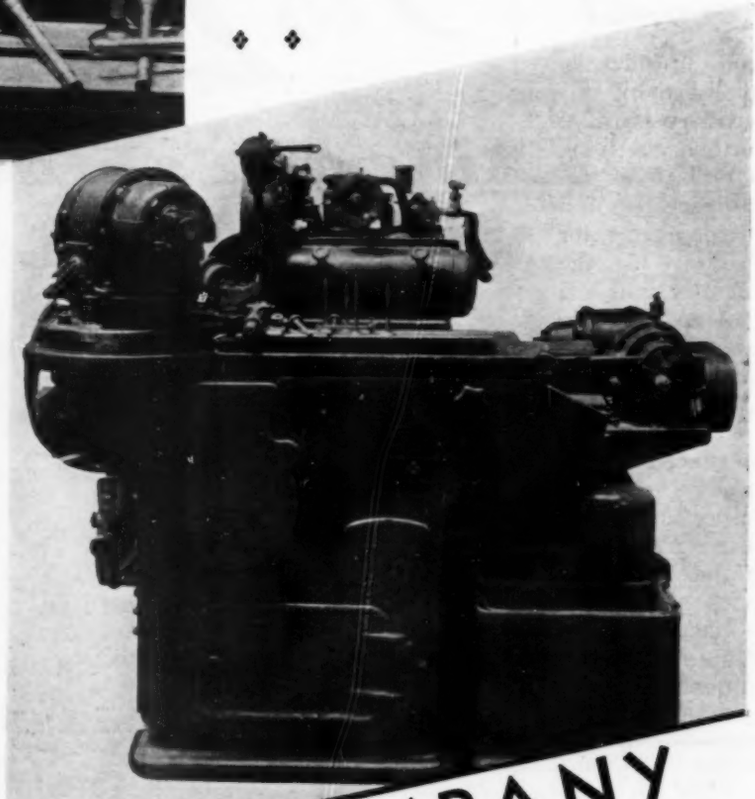
THIS LANDIS GRINDS 400 VALVE FACES PER HOUR



YES, it is possible to grind 400 valve faces per hour.

On a comparatively simple yet fully semi-automatic Landis machine. Stock removal at this rate of output is .010" to .015". Finish is not sacrificed in the least. All the operator does is load and unload the machine. It is not even necessary for him to manipulate a single control.

Valve manufacturers are urged to investigate further. So doing will give us an opportunity to carefully and fully explain the features of this machine.



AS the operator inserts the end of the valve stem in the chuck the wheel carriage starts moving toward the work, the work is clamped, causing rotation to start and the wheel starts to feed in. Just after the left-hand edge of the wheel passes the valve face the wheel comes in contact with the work and continues to feed in slightly for an instant. Immediately before the right-hand edge of the wheel would start to pass off of the valve face the wheel starts to withdraw. The direction of the wheel carriage reciprocating movement changes, carrying the wheel away from the work, this unchucking the valve and causing an ejector rod to push the valve out of the chuck. The operator removes the ground valve, places an unground valve in position and the entire cycle is repeated. At no time during grinding does the wheel face pass off of the work--a very important consideration from the standpoint of finish and wheel wear.

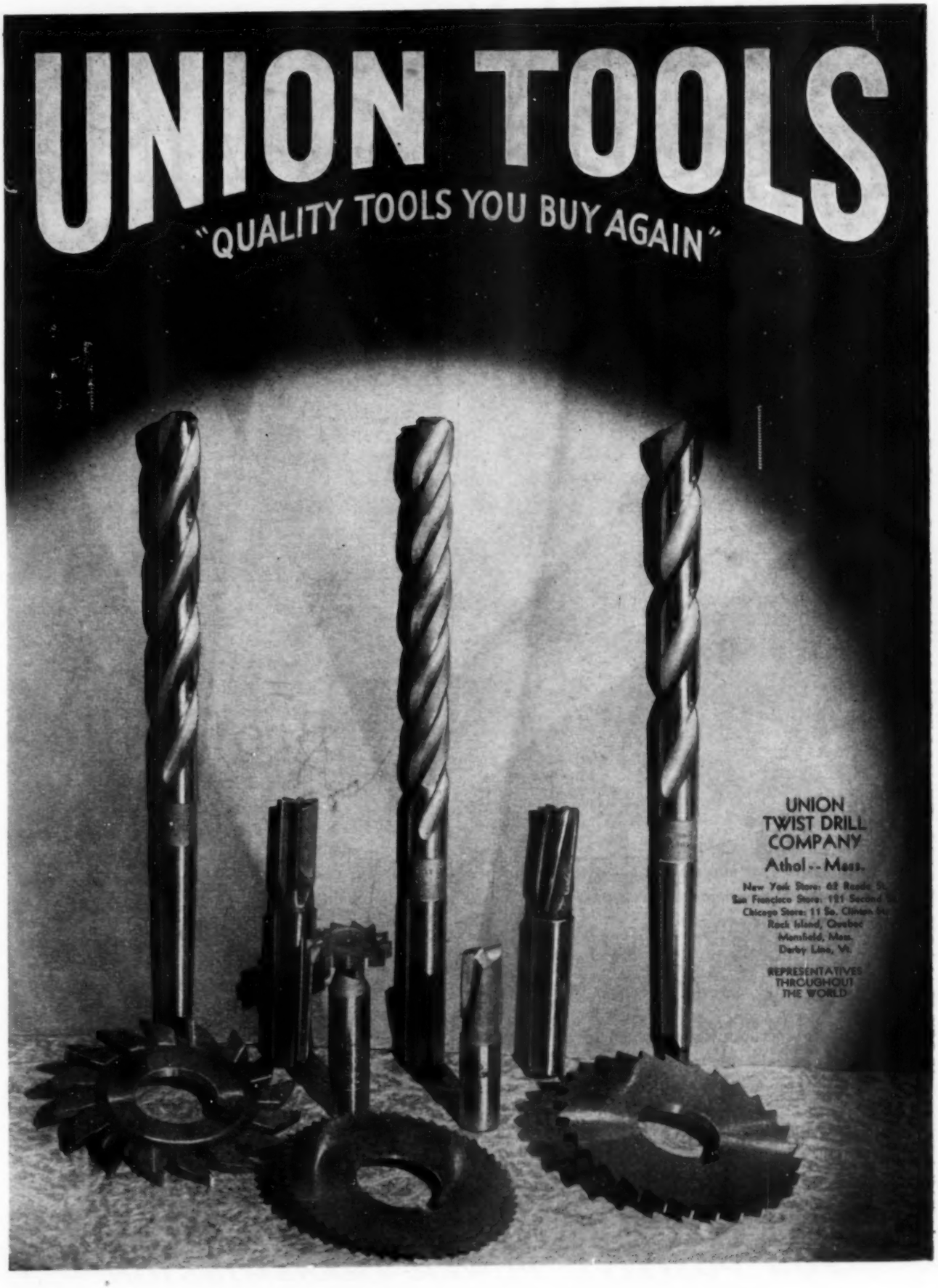
LANDIS TOOL COMPANY

WAYNESBORO, PA., U. S. A.

121

UNION TOOLS

"QUALITY TOOLS YOU BUY AGAIN"



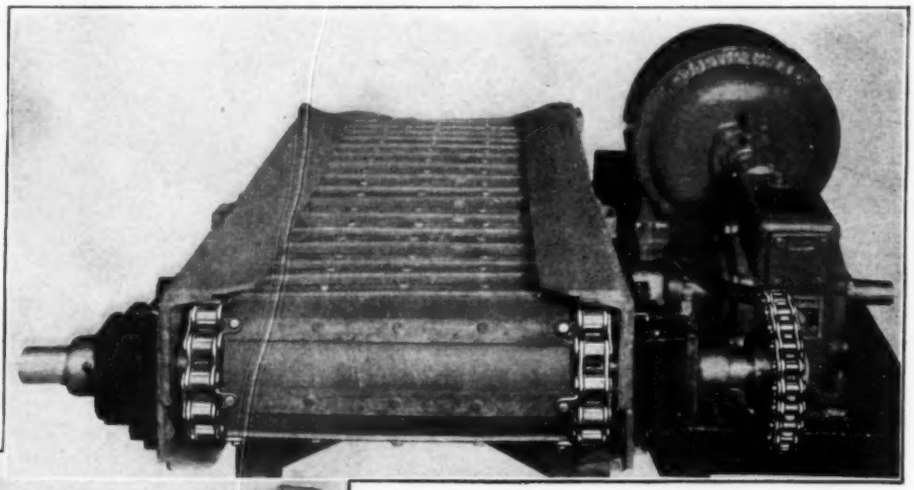
UNION
TWIST DRILL
COMPANY
Athol -- Mass.

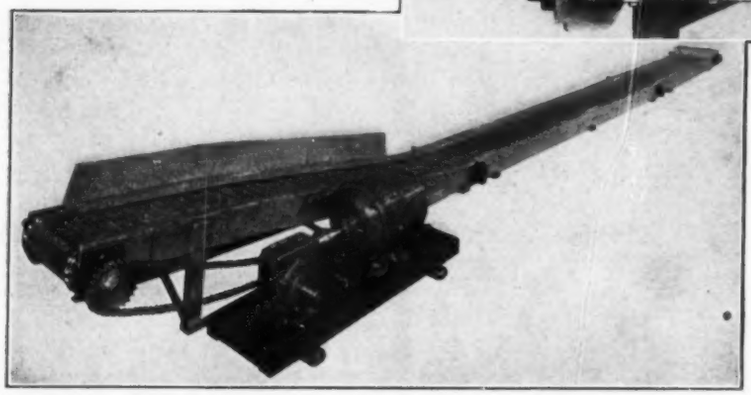
New York Store: 62 Reade St.
San Francisco Store: 121 Second St.
Chicago Store: 11 So. Clinton St.
Rock Island, Quebec
Mansfield, Mass.
Derby Line, Vt.

REPRESENTATIVES
THROUGHOUT
THE WORLD

WHITNEY ROLLER CHAIN

FOR CONVEYOR SERVICE





is a Profitable Investment

Long life, flexibility of application and the ease with which exacting conditions of operation can be met are the reasons why WHITNEY Roller Chain is used profitably in conveyor service.

Whether the work requires the movement of light parts in process or the conveying of heavy bulky material there is a WHITNEY Roller Chain to fit the need.

WHITNEY manufactures Roller Chain in all pitches from 3/8" to 2" and with standard and special attachments to meet varied working conditions. Whitney engineers will gladly work with you on your conveying problems.

THE WHITNEY MFG. CO., HARTFORD, CONN.

Sales and Engineering Offices

CHICAGO	549 W. Wash. Blvd.
BOSTON	10 Mt. Auburn St.
DETROIT	2-240 Gen. Motors Bldg.
CLEVELAND	1213 W. Third St.
PHILADELPHIA	133 S. 36th St.
NEW YORK	250 W. 54th St.
SAN FRANCISCO	1142 Howard St.
SYRACUSE	201 Norwood Ave.

Agents in Principal Cities

WHITNEY SILENT AND ROLLER CHAIN DRIVES

FOR POSITIVE POWER TRANSMISSION

Any Plant can Reduce Tool Costs by this Simple Method...

MACHINE shops are making large savings by chromium plating tools. Tools are often made to last much longer, and may frequently be reclaimed when the chromium is worn through.

Scores of plants have proved that chromium plating reduces tool costs. We cite just a few typical examples of how it has multiplied tool life to show you the possibilities:—

Reamers working in brass lasted 6 to 7 times longer. Milling cutters used on copper did from 3 to 4 times more work between grindings. Some drills plated in 1929 are still in service drilling hard iron castings. Production of burnishing bars was raised from 900 pieces to 4000 pieces. Files used on cast iron and various types of steel wore from 3 to 9 times longer. Nickel tube drawing dies produced an average of 10 times more work per set-up. Molding dies formed 400 per cent more porcelain parts.

Try chromium plated tools. See how much longer they wear, and how easily and economically they can be salvaged when they are worn.

Two ways to assure satisfactory results . . .

Occasionally we run across a concern which has "experimented" with chromium plating and is disappointed with results. Improper plating is usually the cause. The secret of successful tool plating is the use of proper plating methods, as scores of machine shops have proved.

There are two ways by which you may take advantage of the economies of tool plating and insure satisfactory plating results. Either do the plating job in your own plant, with the guidance and advice of our service engineers, or send your tools to plating shops which, operating under our license, have the benefits of our experience and service.

Feel free to write us for advice or further information. We want to help you obtain the full advantages of chromium plating.

UNITED CHROMIUM, INC

Executive Offices: 51 East 42nd Street, New York City

DETROIT SAN FRANCISCO WATERBURY

Production Figures Improve *when* MORSE Tools do the Cutting

The Morse Line includes High Speed and Carbon

- DRILLS
- REAMERS
- CUTTERS
- TAPS AND DIES
- SCREW PLATES
- ARBORS
- CHUCKS
- COUNTERBORES
- MANDRELS
- TAPER PINS
- SOCKETS
- SLEEVES

PRODUCTION figures cannot help showing a change for the better when the cutting tools last longer between sharpenings as MORSE tools do.

Careful accounting in thousands of plants has given MORSE Tools full credit for reduced production cost and increased production output.

MORSE

TWIST DRILL & MACHINE COMPANY

NEW BEDFORD, MASS., U.S.A.

It has what all drill spindles need

THE best drill in the world needs sturdy, rigid support to give best results. That is why the Gray Hub Company, of Detroit, builders of multiple spindle drill heads, are enthusiastic about the New Departure Double Row Ball Bearing. Life-long rigidity is set up in the bearing by preloading it at assembly. It never needs further adjustments by machine builders or users. Other features that recommend it for drilling purposes are accuracy, high thrust capacity and speed ability. The unit shown above was built by Gray for a large automobile concern. It drills connecting rods and caps at the rate of fifty per hour. » » » New Departure engineers, in many jobs, have eliminated the need for two bearings of other types by using this Double Row. Why not expose your bearing problems to solution by these skillful and resourceful engineers? » » » The New Departure Mfg. Co., Bristol, Conn.

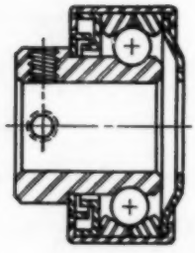
NEW DEPARTURE
BALL BEARINGS

Better Bearings at Moderate Prices Offer a Combination Consistent With Present Business Conditions

MANUFACTURERS in all industries where ball bearings are used, are turning to "COMMERCIALS" because these bearings exactly meet present conditions. Not only a *better* bearing, but designed to suit every need and purpose at very nominal cost.

You can obtain stock bearings, or bearings made to your own specifications. You can buy bearings that give excellent service—bearings with a larger number of balls which add to efficiency. Speeds up to 2500 R.P.M. and *dual* thrust capacity. Three-point contact and other features which have contributed so much to "COMMERCIAL" Annular Ball Bearing popularity. Let us place complete details before you. Then judge for yourself the many advantages in "COMMERCIAL" quality and price.

Write For Information, Price List and Samples



Typical Installation

THE SCHATZ MANUFACTURING CO., POUGHKEEPSIE, NEW YORK
Detroit Sales Office: 917 Book Bldg. Chicago Sales Office: 120 N. Peoria St.

"Commercial" BEARINGS

THEY MAY LOOK ALIKE . . .

BUT—

THIS DRILL PAID A PROFIT

This drill cut production costs by speeding up drilling operations.

First—it was easier to start. Second—it produced more "inchage" per minute and per grind. Third—the holes it produced were always true cylinders and "to size", greatly facilitating assembly problems.

Why? Because it was always given the scientifically correct Sellers Drill Point having both lips ground equal in length, and with the same inclination to the axis. Hence, each lip did an equal share of the cutting.

This same superior point was reproduced automatically, over and over again on a Sellers Drill Grinder in the central tool room, where all drills were kept in condition by the tool room boy, freeing machinists from costly delays.

WHILE THIS DRILL DID NOT

This drill—a duplicate of the drill above in every respect except its point—increased production costs by slowing up drilling operations.

First—it was hard to start. Second—it required more time and power for penetration and dulled quickly. Third—the holes it produced were not true cylinders—were oversize, requiring bushings or special oversized parts.

The workman was blamed, for hadn't he taken ample time away from his machine to grind this and other drills by hand? Hadn't his idle machine hours wasted away the profits on the job?

A rank injustice to any good machinist. For no man can consistently approach the accuracy of the Sellers Point by hand. No man should be expected to attempt it, when a tool room boy with a Sellers Drill Grinder can quickly and easily reproduce this profitable point on one or a million drills.

SELLERS MACHINE TOOLS

DRILL and TOOL GRINDERS . . . PLANERS . . . PLANER TYPE MILLERS . . . FLOOR BORERS . . . BORING MILLS . . . RAILROAD SHOP TOOLS . . . SPECIAL MACHINES

WILLIAM SELLERS & COMPANY
ESTABLISHED 1849 INCORPORATED PHILADELPHIA, U.S.A.

CARD
Round Adjustable
DIES

In all sizes

for hand and screw machine use

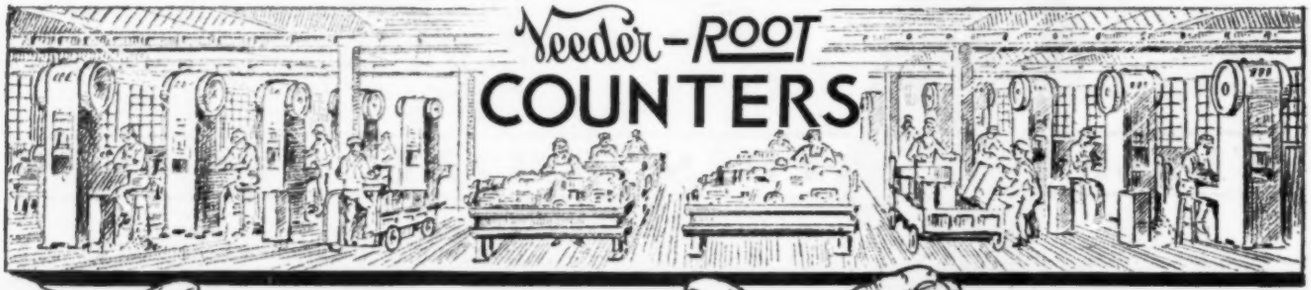
We have these dies in stock in all sizes, threads and outside diameters, for immediate shipment.

Their biggest recommendation is the results obtained in use—results which have led users to standardize on CARD Dies for all time, and to discontinue the costly practice of shopping around.

Try and Buy CARD Dies

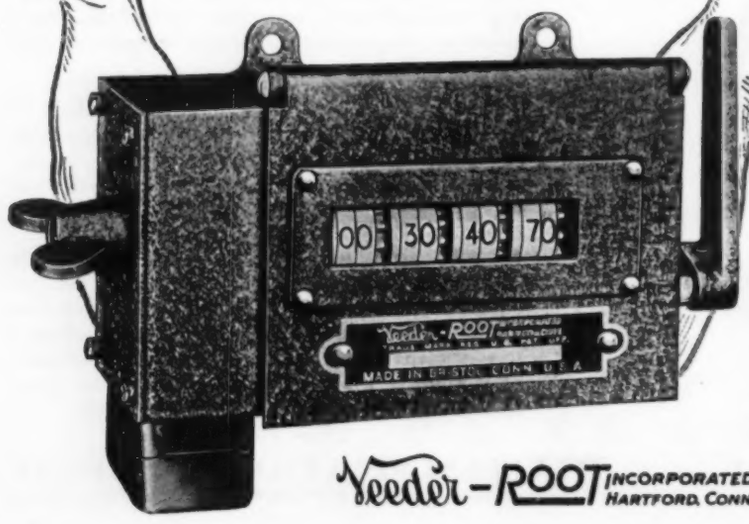
Catalog 32 gives full list of sizes and prices. Send for it — order from it — and remember you get immediate shipment from stock.

S.W.CARD MFG. CO.
DIVISION OF UNION TWIST DRILL CO.
MANSFIELD, MASSACHUSETTS, U.S.A.



Veeder-ROOT COUNTERS

SUPPORT *PAYING* PRODUCTION



THEY SUPPORT **the work of men and machines in getting production without time-loss or material-waste.**

THEY UPHOLD **your plans for production-CONTROL with production-RECORDS on all jobs.**

They back up your estimates by helping keep final costs within preliminary figures.

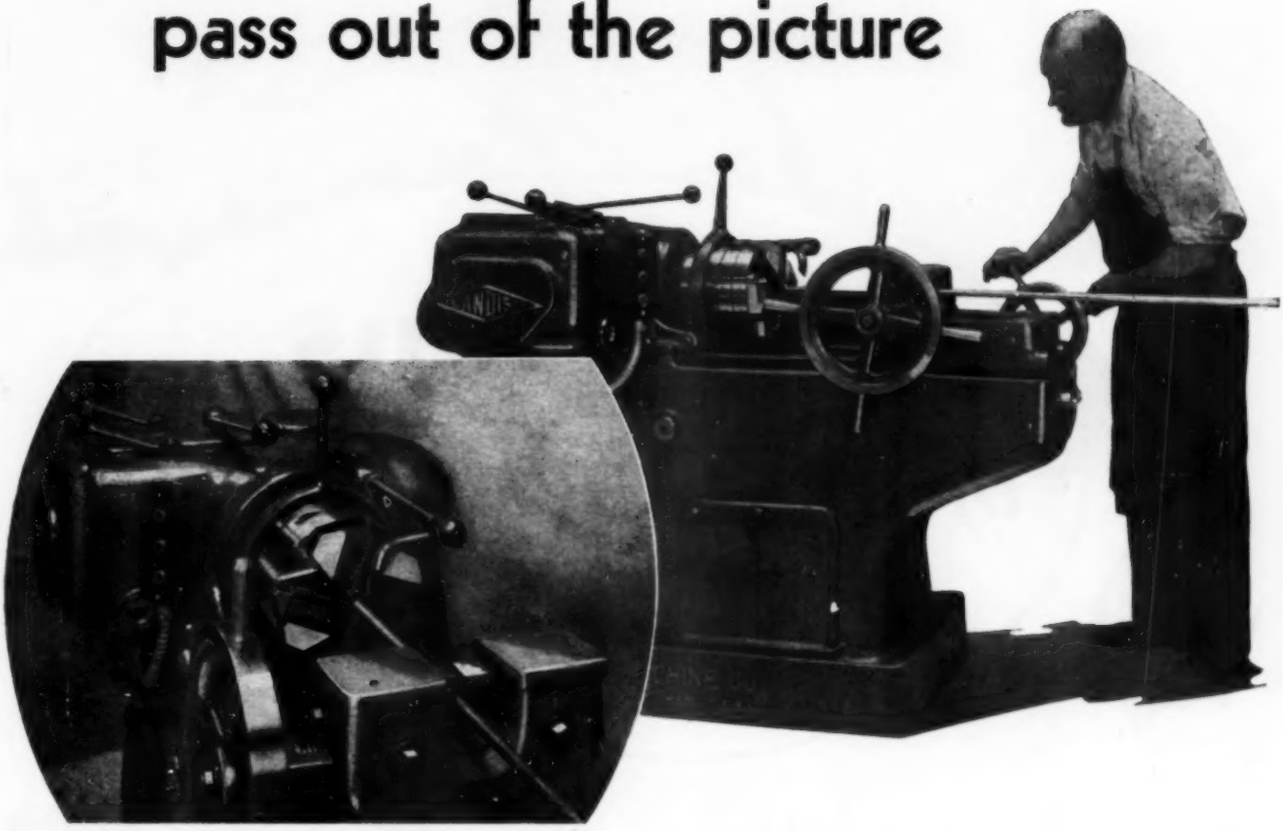
They give you a lift in getting the orders you have to get on PRICE. They push up the margin of profit on "regular" orders. . .

On what type of machines would you like these results?

Veeder-ROOT INCORPORATED HARTFORD, CONN.

BUILDERS OF COUNTERS FOR EVERY PURPOSE ★ ★ ★ OFFICES IN THE PRINCIPAL CITIES

"Loose fits" pass out of the picture



The day of the "loose fit" as a screw thread standard is gone.

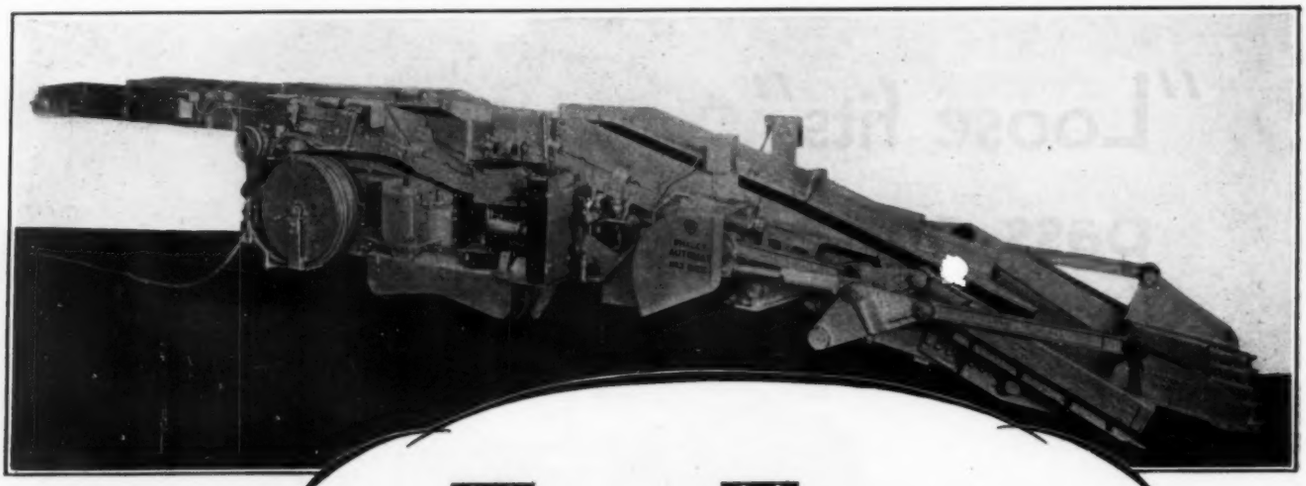
It was an easy standard to work to — easy to produce and easy to assemble — but it was an expensive standard.

With the LANDMACO Threading Machine it is just as easy to produce your threaded parts to modern standards as it was for the old "bolt cutter" to cut a "loose fit" thread.

The LANDMACO is designed for modern threading operations — it will produce your threads within definite limits for lead, pitch and included angle. In addition, the higher speed range of the LANDMACO will enable you to increase production.

Literature on this *new* threading machine is yours for the asking.

LANDIS MACHINE COMPANY, INC.
WAYNESBORO, PENNA.
Detroit - 5928 Second Blvd. : : Cleveland - 505 Marshall Bldg.
AGENTS IN ALL THE PRINCIPAL CITIES OF THE WORLD



Two Tons *of* Coal *per* Minute *Guaranteed*

A guarantee that insures continuous duty, high capacity and swift manipulation in this 7½ ton Whaley Automat Shoveling Machine—a guarantee that rests squarely on the fifteen Fafnir Ball Bearings used in the drive assembly, for on their dependable operation rests the performance of the entire machine.

Another feature of this thirty-foot coal loader is the low power consumption and still lower maintenance. Here again the Fafnir Ball Bearings play a vital part with their unusual capacity and precision, their ability to retain lubricant and their trouble-free performance.

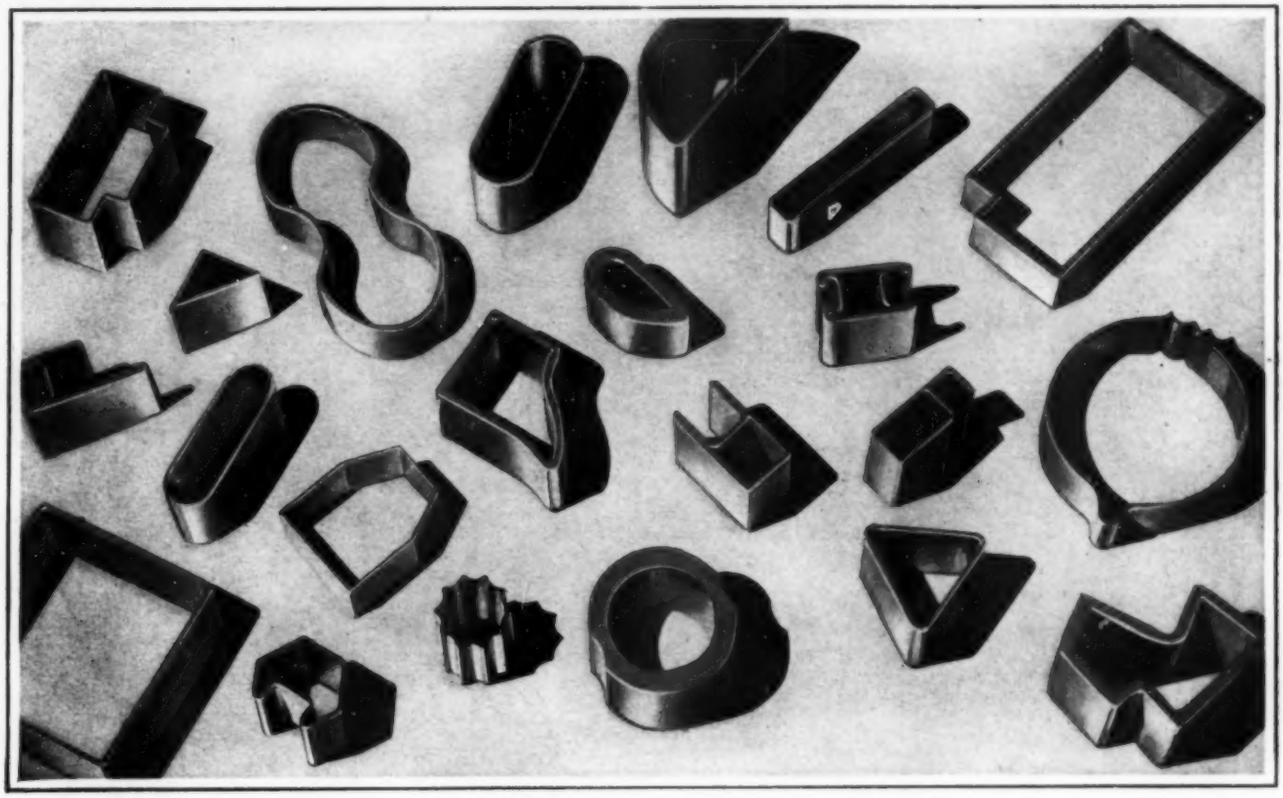
The exclusive choice of Fafnirs is a tribute not only to the quality of the bearings themselves but also to the skill of Fafnir Engineering Service in supplying the bearing precisely suited to the need. This service is yours—anytime—without obligation.

The November Dragon carries the complete story of this interesting application and contains a number of other articles of value to all those concerned with ball bearing problems. Be sure not to miss this issue.

THE FAFNIR BEARING COMPANY, New Britain, Conn.

Atlanta Chicago Cleveland Dallas Detroit Los Angeles
Milwaukee Newark New York Philadelphia Indianapolis

Fafnir·Ball·Bearings



Consider the advantages of Anaconda *seamless* tubes

WE MANUFACTURE irregularly shaped seamless tubes . . . in a wide range of copper alloys . . . in practically every conceivable shape and size. In fact, size limitations are imposed only by the thinness of the metal and the complexity of the shape.

Anaconda seamless tubes offer rigidity of construction, coupled with lightness in weight. They are rust-proof and durable . . . and attractive. And they are more satisfactory and lower in cost than similar parts fabricated from sheet.

If you are one of these alert manufacturers who have investigated the design, production and performance possibilities of tubular shapes, consider also the additional advantages of *seamless, durable, copper-alloy tubes.* We are prepared to supply a large number of stock shapes and sizes . . . and to quote upon and produce tubes to your individual specifications.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

ANACONDA COPPER AND BRASS

Here are the targets for today's advertising . . . we've put them

"ON THE SPOT"

for you

Advertising that goes gunning for business today must be unerring in its marksmanship. No stray shots at outsiders who can't possibly mean anything to you. Today's advertising must aim only at your logical prospects. And get them.

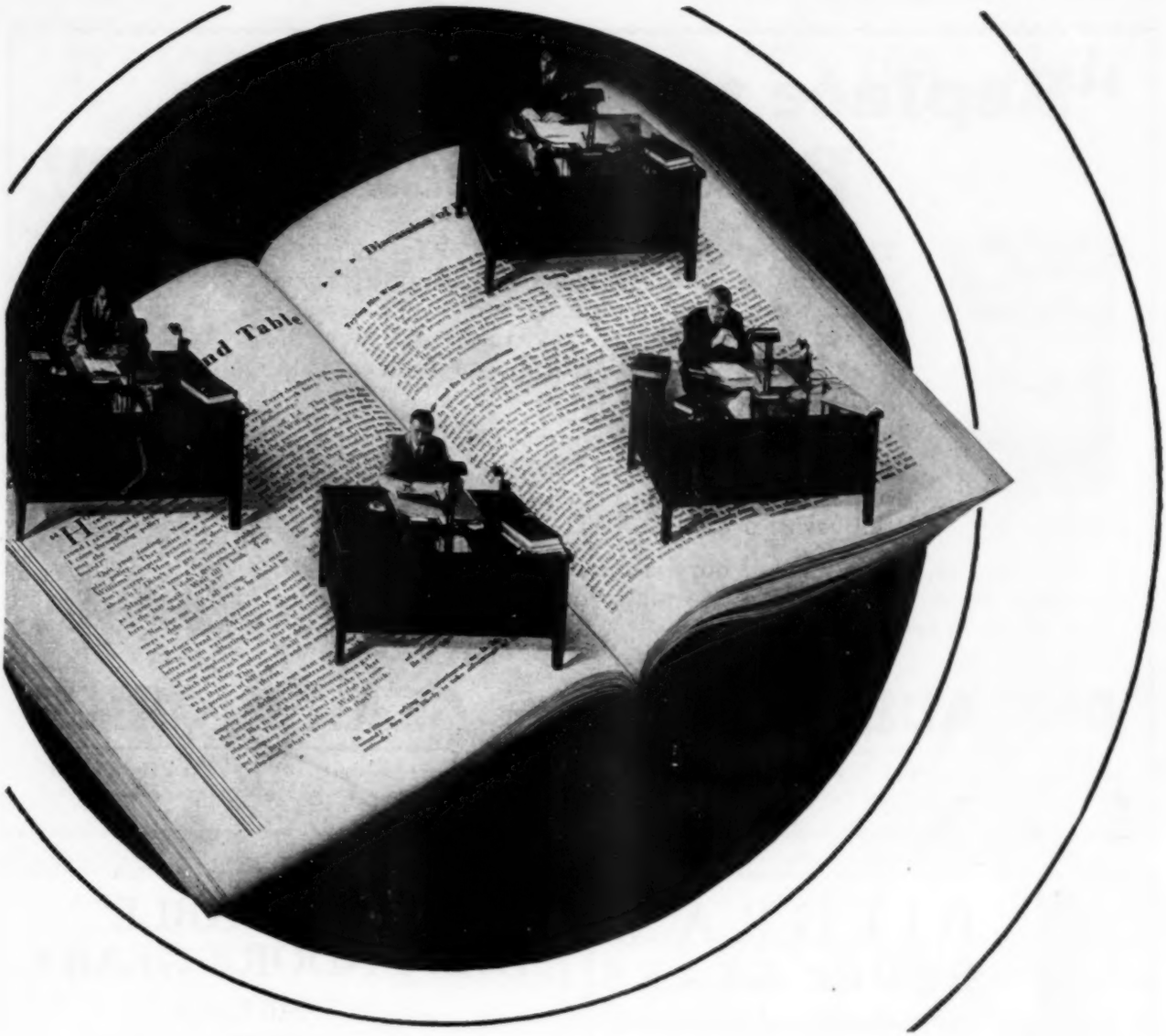
That calls for setting the stage in advance. Singling out the profitable prospects. Put-

Jobs that business paper advertising can do NOW

Business paper advertising is a ten-fold aid to your salesmen in getting orders . . . today. Here's one way it helps.

It can make your salesmen's time more effective by introducing your product in advance, telling your sales story, priming prospects for them.

This, and the other uses of business paper advertising are explained in our book, "Industrial Advertising at Work." We will gladly send you a copy on request.



ting them on the spot, where you'll hit them all—with no shots wasted.

McGraw-Hill has done just that for those who sell to business and industry. In the character of their editorial content, McGraw-Hill publications appeal only to the men who initiate and control buying for business and industry—over half-a-million of them. These men are not just "readers". Sixty-nine per cent of those questioned recently stated that they use their business magazines as buying guides.

Here they are—the target for today's advertising. We've lined them up, put them on the spot for you. They're waiting for you to "Aim . . . Fire!"

AMERICAN MACHINIST

A McGraw-Hill Publication

330 West 42nd Street
New York, N. Y.

"Replace those Worn or Broken Gears, Now"

Continuous Tooth Herringbone Gears

Throughout your shop, there may be machines operating with badly worn or partially broken gears. Such gears are apt to cause trouble, delay and expense at any time,—so why not avoid THIS POSSIBILITY and replace those gears NOW?

"Phillie Gear" has been making Gear Replacements of all types for nearly a half century,—and their deliveries are PROMPT.

Bevel Gears

By the way, if you haven't our well known "Gear Book," we'd be glad to mail you a copy upon request.

PHILADELPHIA GEAR WORKS

PHILLIE GEAR

Industrial Gears and Speed Reducers
Branch Sales and Engineering Offices:

Erie Avenue and "G" Street, Philadelphia
NEW YORK: 330 W. 42d St.—PITTSBURGH: Farmers Bank Bldg.

BILGRAM BEVEL GEARS

SPIRALOID and STRAIGHT GENERATED TEETH

UP TO 15:1 RATIO

AND EVEN GREATER

ALL TYPE GEARS

BILGRAM GEAR & MACHINE WORKS
1217-35 Spring Garden St., Philadelphia, Pa.

DEPENDABLE DIEFENDORF GEARS

ALL METALS

MICARTA
CELORON
RAWHIDE

Spur, Straight Bevel, Spiral Bevel
Helical, Internal

DIEFENDORF GEAR CORPORATION
SYRACUSE, N. Y., U. S. A.

GEARS

GRANT GEAR WORKS
BOSTON MASS

GEARS - WORMS - CAMS - MADE TO ORDER

HARTFORD GEARS

THE HARTFORD SPECIAL MACHINERY CO., Hartford, Conn.

MP

MEISEL GEARS . . . .

have been building a high reputation for 24 years. Better gears are not made. Also tooth rounding, broaching, splining, screw machine work, gear tooth grinding and heat treating.

MEISEL PRESS MFG. CO.
946 Dorchester Ave., Boston, Mass.

BROWN & SHARPE

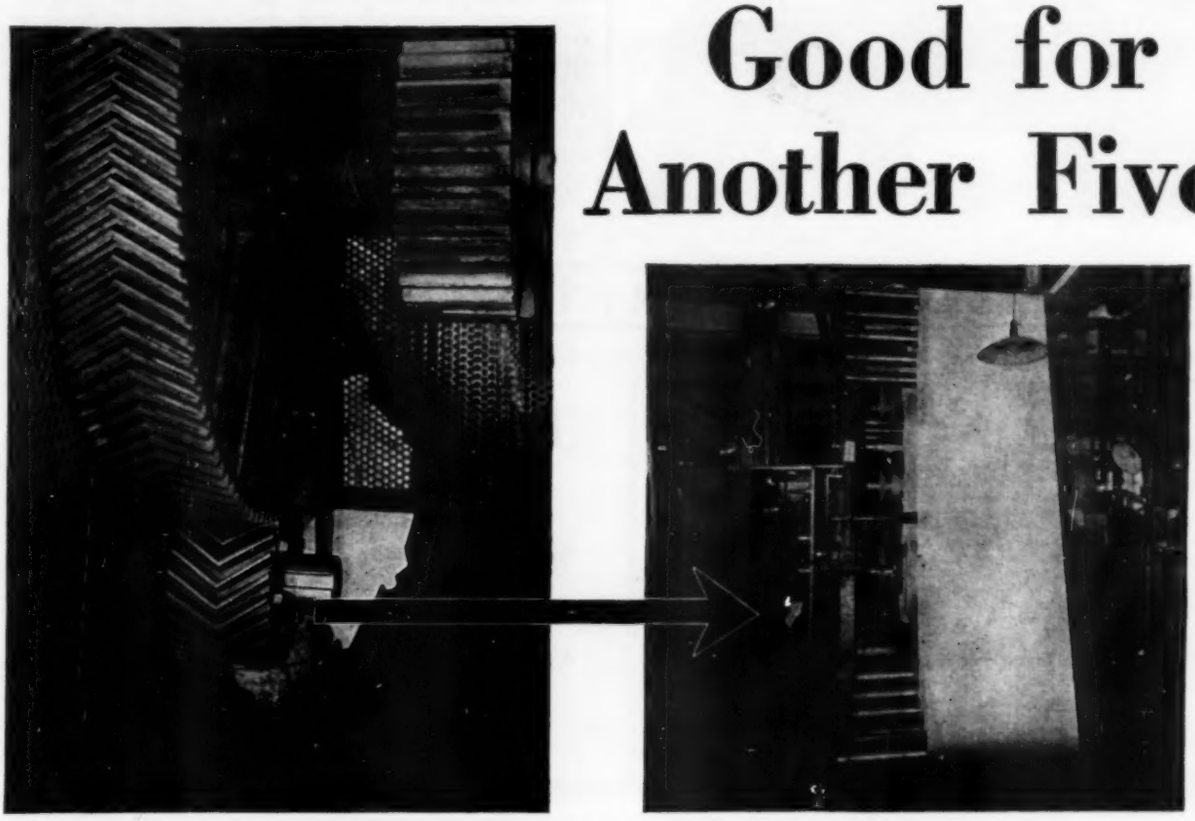
GEAR SERVICE

B·S

High Grade Gears of all types
Cut to Order

BROWN & SHARPE MFG. CO., Providence, R. I., U. S. A.

"Five Years in Service and Good for Another Five"



G-E Textolite herringbone pinion operating a five-bowl calender machine in the Delta Finishing Company, Philadelphia, Pa.

Distributors for G-E Nonmetallic Gears

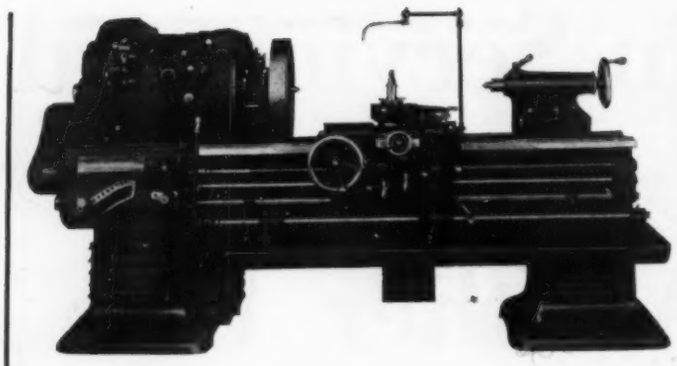
Boston Gear Works Sales Co., *North Quincy, Mass.*
Braun Gear Corp., *Brooklyn, N. Y.*
Chicago Rawhide Manufacturing Co., *Chicago, Ill.*
Cincinnati Gear Co., *Cincinnati, Ohio*
Cragg Gear & Machine Works, *Kansas City, Mo.*
Diefendorf Gear Corp., *Syracuse, N. Y.*
Foote Bros. Gear & Machine Co., *Chicago, Ill.*
Gears & Forgings, Inc., *Cleveland, Ohio*
Horsburgh & Scott Co., *Cleveland, Ohio*
Johnson Gear & Manufacturing Co., Ltd., *Berkeley, Calif.*
Kreiter Gear & Machine Co., *Houston, Texas*
The Medart Co., *St. Louis, Mo.*
Michigan Gear & Engineering Co., *Detroit, Mich.*
Philadelphia Gear Works, *Philadelphia, Pa.*
Pittsburgh Gear & Machine Co., *Pittsburgh, Pa.*
Portland Iron Works, *Portland, Oregon*
San Antonio Machine & Supply Co., *San Antonio, Texas*
J. Zagora Machine & Parts Co., *Charlotte, N. C.*

THAT'S what the manager of the Delta Finishing Company said when we asked him how long this G-E Textolite pinion had been in service. This eight-inch Textolite herringbone pinion transmits power from a 40-hp., 1200-rpm. motor to a five-bowl cloth calender machine on which the bowl pressure varies from 15 to 20 tons. Longer life, quieter operation, and minimum companion-gear wear were the qualities that the Delta Finishing Company wanted in this pinion. *They selected Textolite.*

Why not check up on your pinions to-day? Wherever you are having trouble—failure of pinion or companion gear, excessive noise or vibration—install G-E Textolite pinions. They are your assurance of quiet, trouble-free operation. They may be obtained from any of these distributors, or through your nearest G-E office.

830-120

GENERAL ELECTRIC



Exponents of
ADVANCED ENGINEERING

Springfield Lathes incorporate every tried and true feature that will enhance output and easy manipulation. Built-in motor drive makes for compactness—anti-friction bearings throughout—drop-forged and heat-treated gears supply a full complement of spindle speeds, enabling TUNGSTEN CARBIDE TOOLS to be used effectively.

Products of four decades of fine machine tool building, Springfield Lathes are outstanding exponents of advanced engineering.

Bulletin No. 155 explains each feature in detail.

The Springfield Machine Tool Company
Springfield, Ohio, U. S. A.

SPRINGFIELD GEARED HEAD LATHES

NITRIDING!

AMERICAN GAS FURNACE CO. — PIONEERS IN 1918 — LEADERS TODAY

Nitriding, which was invented and patented by A. W. Machlet, President of the American Gas Furnace Company in 1913, is being more widely applied because more suitable steels are now available.

Increased hardness, resistance to corrosion and, as no quenching is required, minimum warpage are some of its advantages.

If you are interested in the possibilities of this new process, our affiliated company is prepared to nitride samples for you.

We will be glad to advise you regarding suitable equipment for nitriding or other heat treating.

Bulletin A.M.20 on request.

AMERICAN GAS FURNACE CO.
Office and Works: Elizabeth, N. J.

MANGANO

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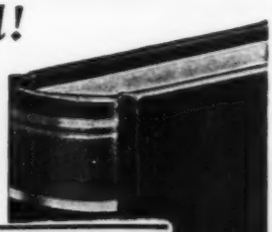

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Fundamental Principles

by WILLIAM P. TURNER

Professor of Practical Mechanics, Purdue University

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The book explains all the underlying principles that form the basis for the development of machine tool cutting operations. These basic principles of cutting feeds and speeds, shapes of tools and how to apply the tools to cutting work, are studied in the detailed operation of standard types of machines: the lathe, planer, shaper, drill press, milling machine, turret lathe, and grinding machine.

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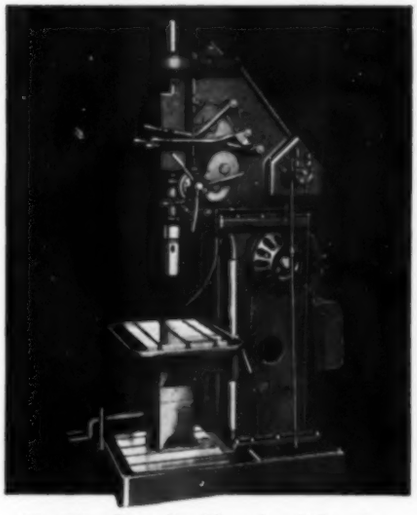

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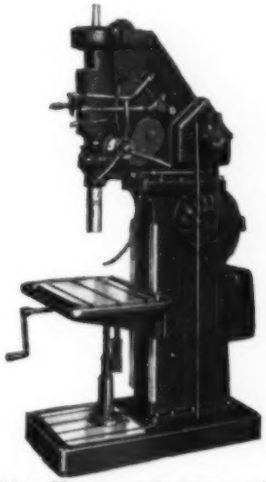

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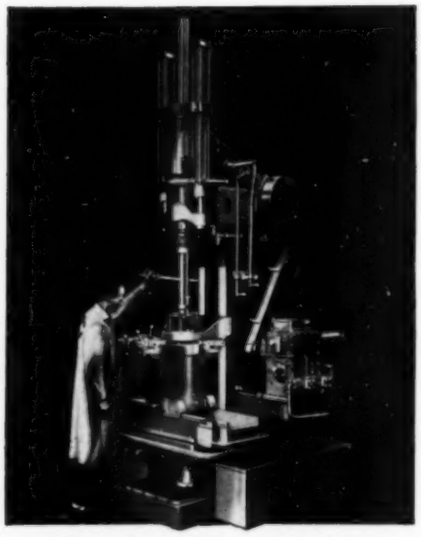

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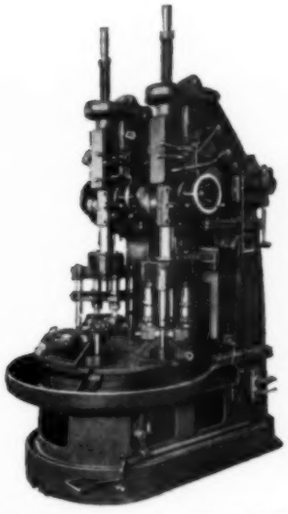

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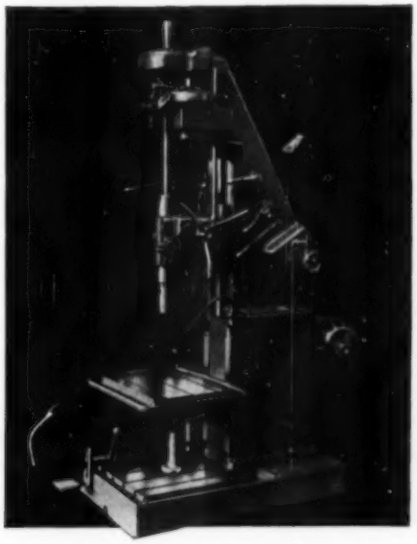

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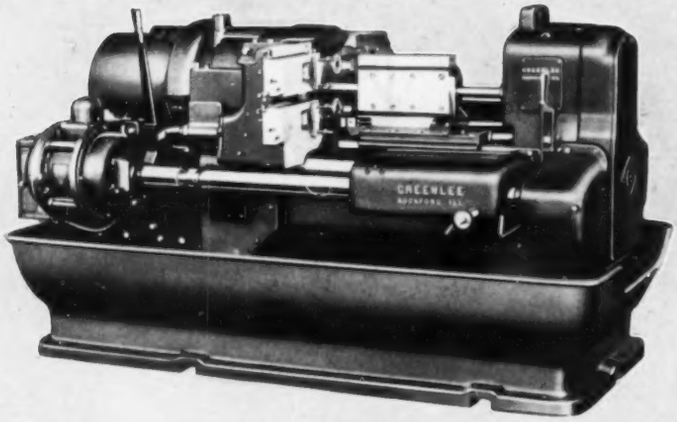

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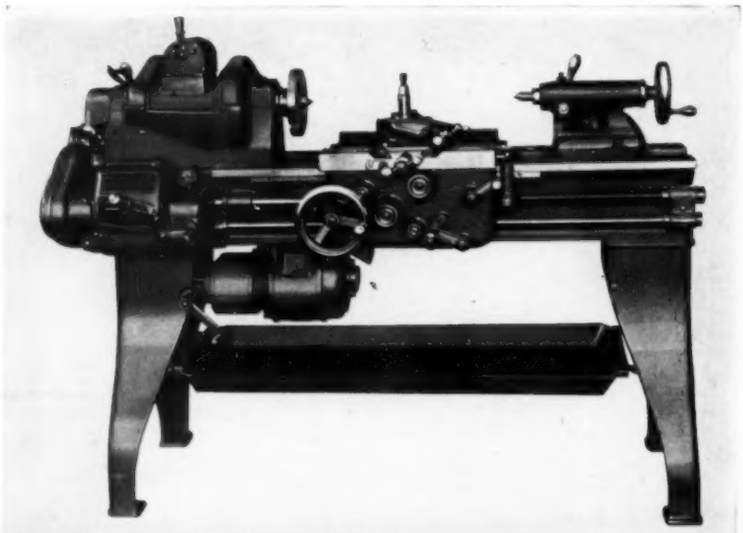

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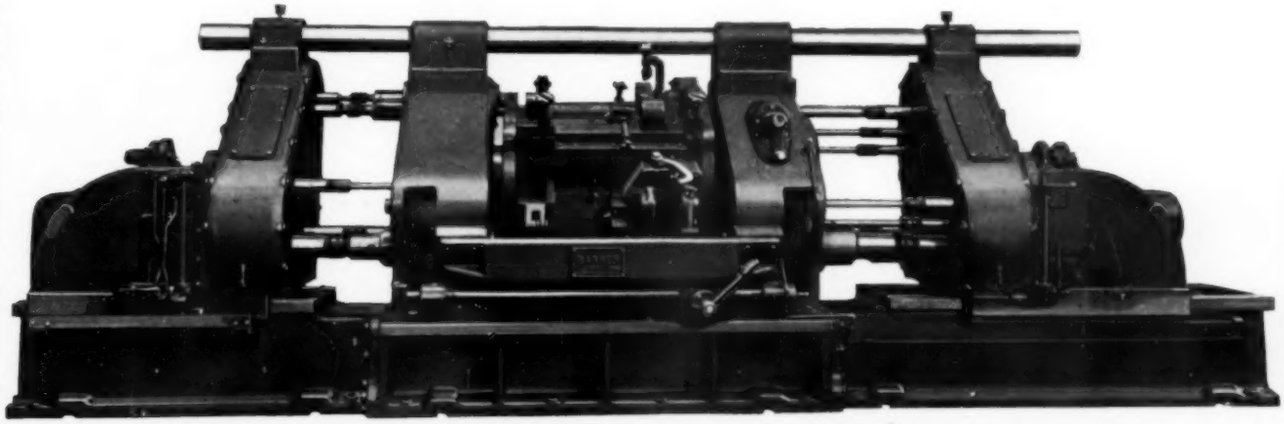

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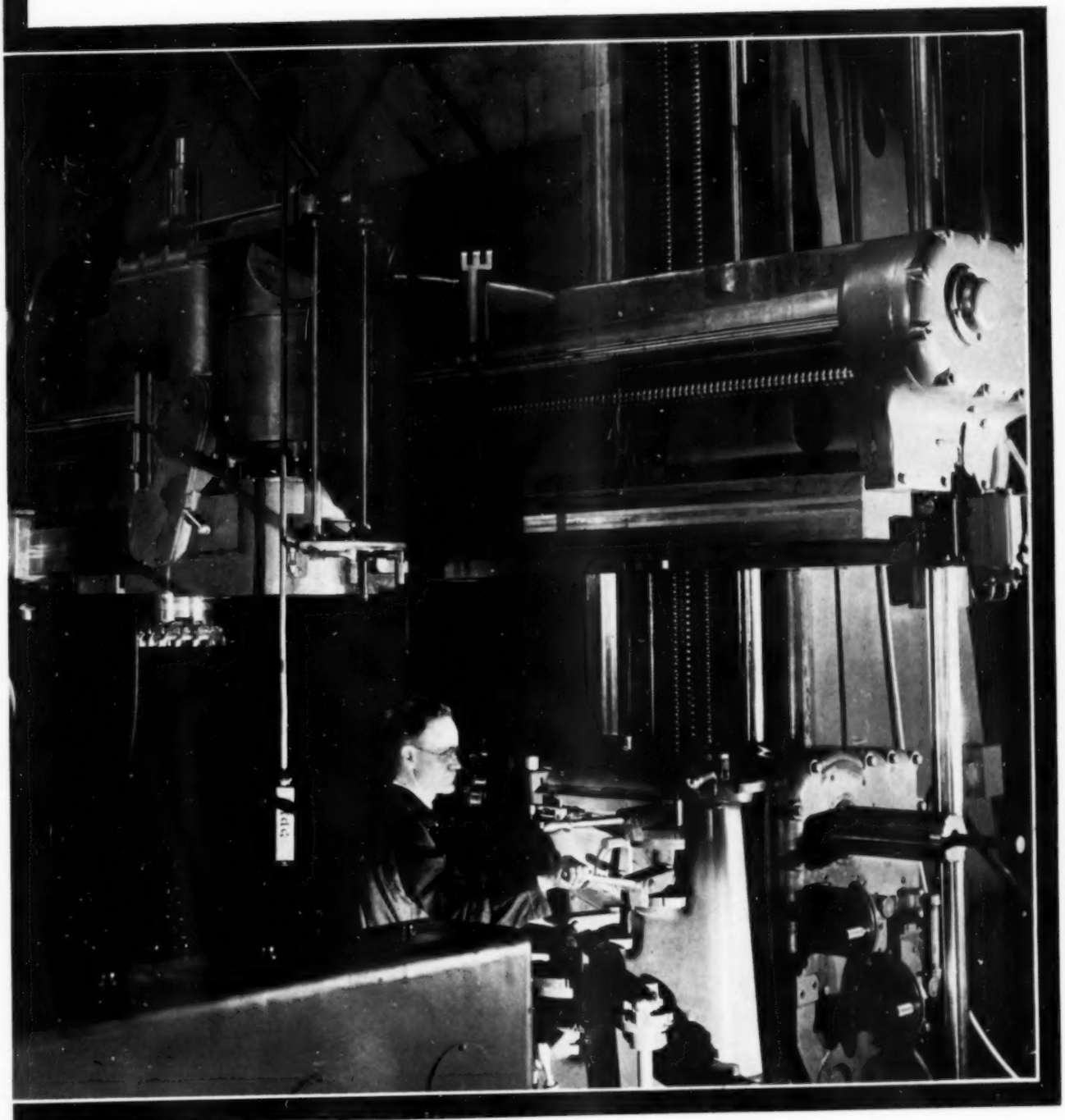

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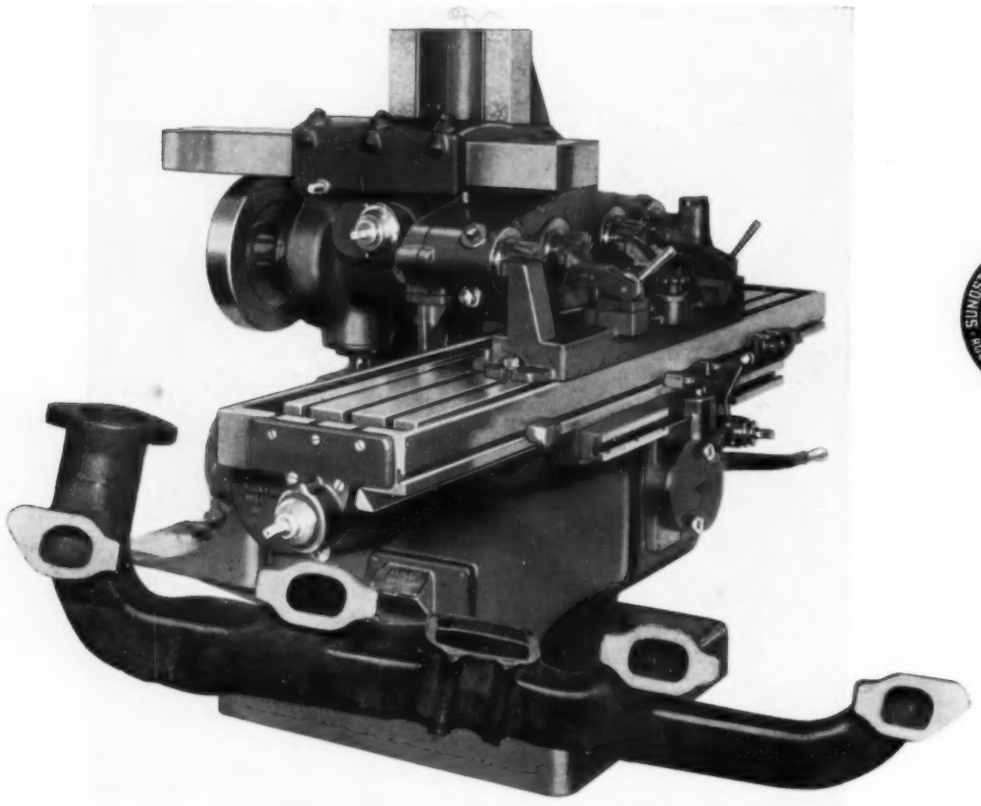
Vol. III, No. 9

ENGINEERED EXAMPLES FROM THE



A RIGIDMIL - 1927

for milling cast-iron manifolds

In January, 1927, the Rigidmil with four-spindle horizontal head shown above was shipped from our factory. Immediately upon installation it went into service milling pads on cast-iron exhaust manifolds. Five years and six months this Rigidmil ran on the work shown.

Then came engineering changes and re-arrangement of production lines. For economy, available equipment had to be used in the new set-up but *only when this could be done profitably*. Down the line went the engineers asking —"Can this machine be used?—On what operation?—Will it pay?"

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The operation is milling four surfaces on crank shaft forgings. The Rigidmil was sent to our plant where it was overhauled and equipped with a new 2-spindle *vertical* head, fixture, and automatic table control.

Shown on the opposite page is the Rigidmil in its new form, with a sample of the work on which it is to run, as it left our factory in September 1932 ready for more years of service in a modern production line. As this is written, similar work is going forward on several more Rigidmils from the same plant.

Above is conclusive proof of Rigidmil value

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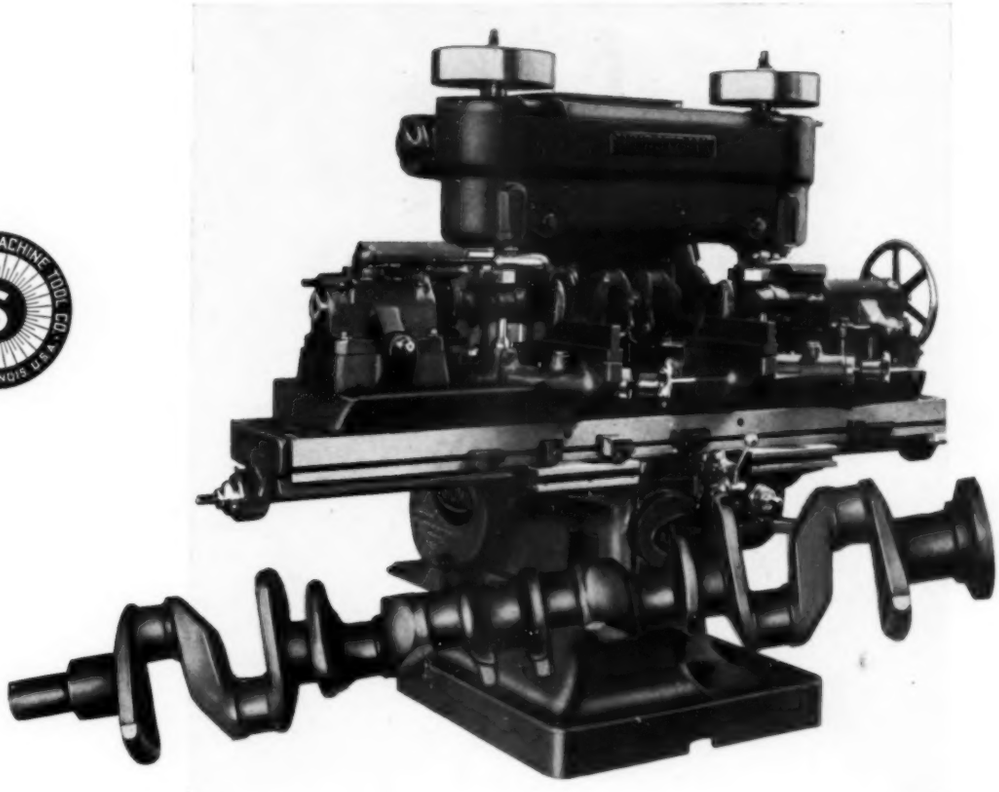

SAME MACHINE - 1932
for milling steel crankshafts

in meeting the conditions of today and protecting the investor in specialized production equipment against obsolescence.

The machine shown above is one of the pioneers in its field. Illustrated at right is the latest Rigidmil development, type 3-B, which has in a greater degree all of the accuracy, productive capacity, durability and economy of its predecessors. All manufacturers of metal products are invited to consult our Engineered Production Department about adapting Rigidmils already installed to meeting present requirements or applying new Rigidmils to the solution of new production problems.

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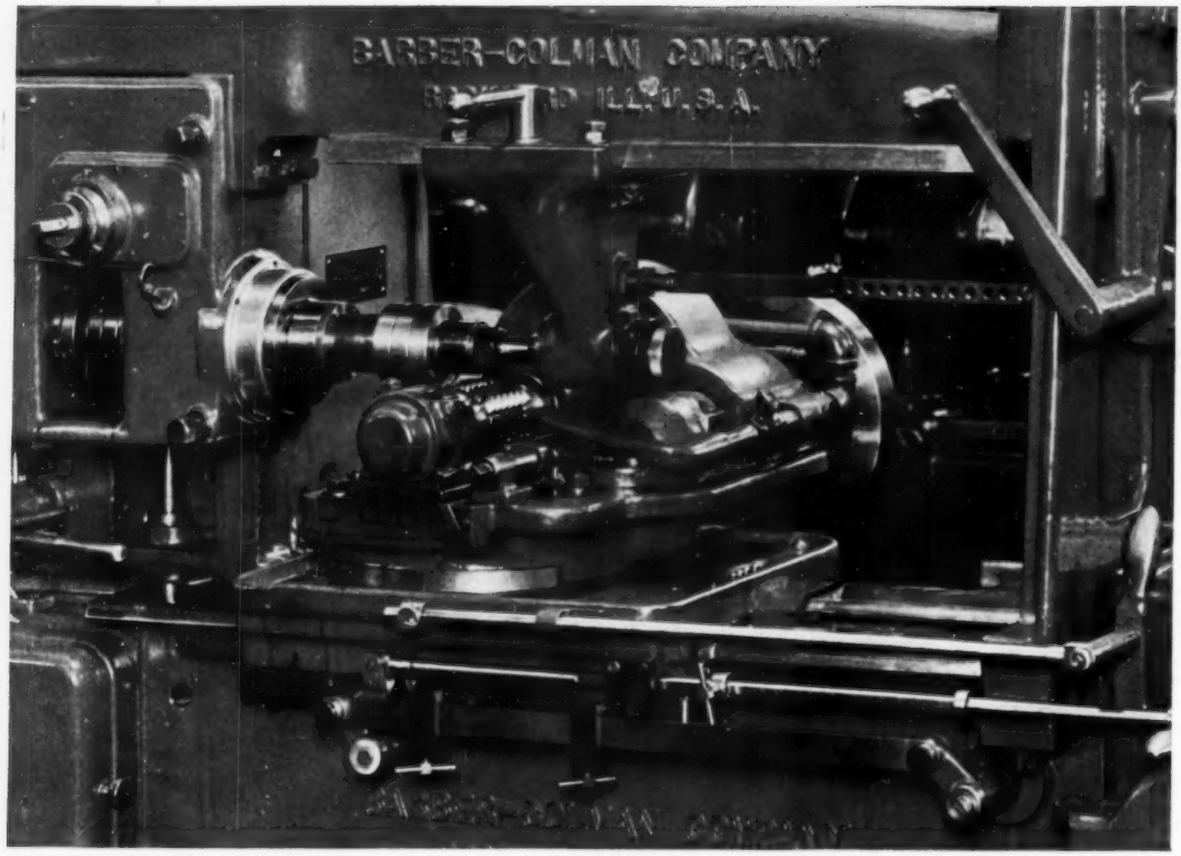

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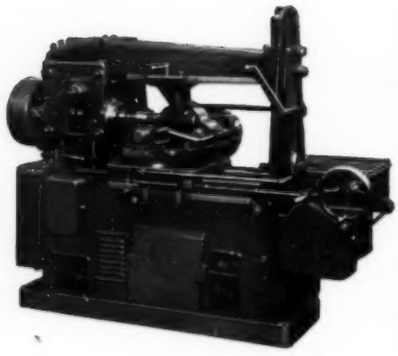

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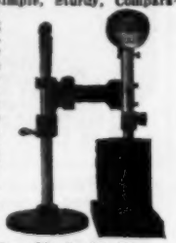

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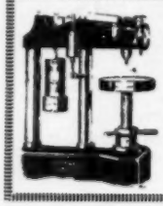

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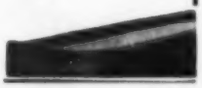

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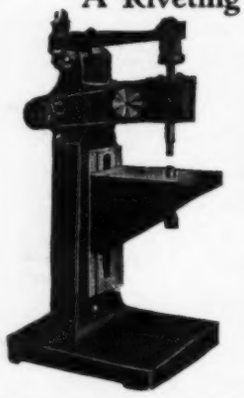

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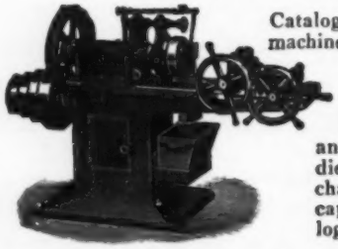

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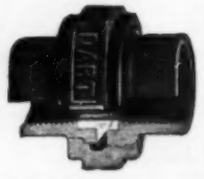

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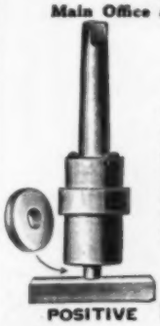

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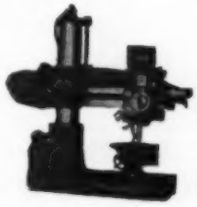

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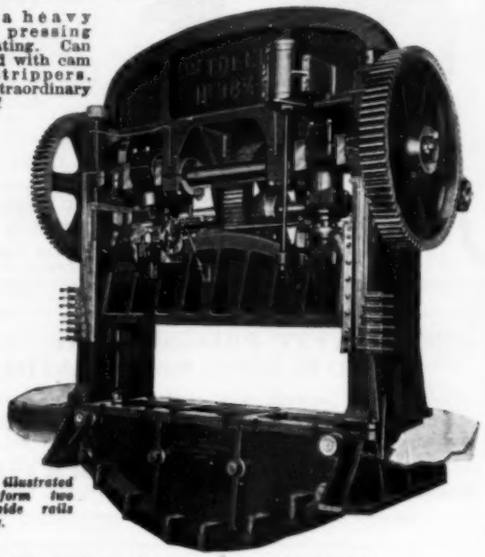

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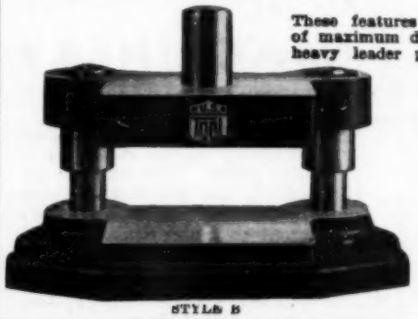

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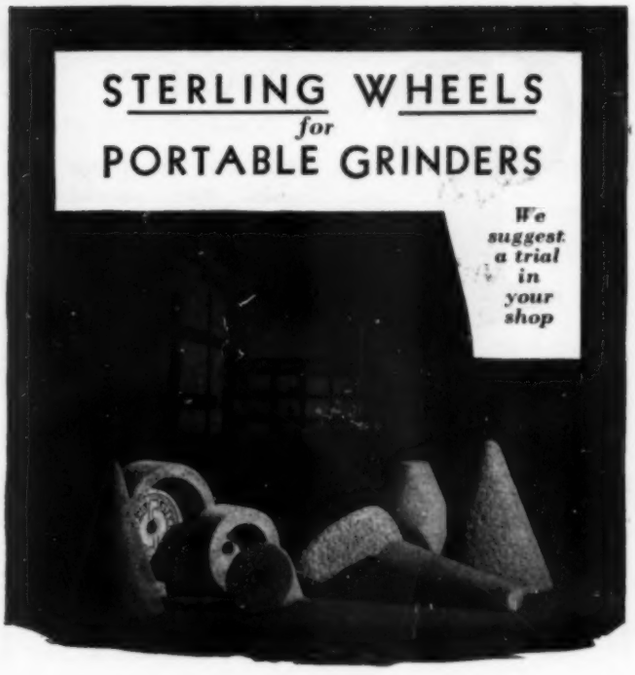

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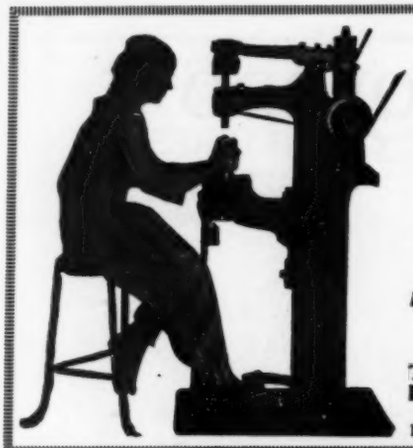

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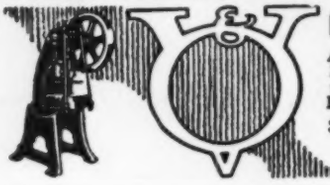

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(Continued on the opposite page)

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WHAT AND WHERE TO BUY

A Classified Index of Advertisers in This Issue

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Peninsular Grinding Wheel Co.

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Elmes Engr. Wks., C. F.

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Morse Twist Drill & Mach. Co.
Sundstrand Machine Tool Co.
Union Twist Drill Co.

BALANCING Ways
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BLOWERS & Fans
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Niles Tool Works Co.
Rivett Lathe & Grinder Corp.
Sellers Co., Inc., Wm.

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CAMS
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CARBURIZING Machines
American Gas Furnace Co.

CASE Hardening and Tempering Compounds
Meisel Press Mfg. Co.

CASTINGS, Iron and Semi-Steel
Springfield, O., Mch. Tool Co.

CENTERING Machines
Sundstrand Machine Tool Co.

CHAINS, Transmission
Boston Gear Wks. Sales Co.
Philadelphia Gear Works
Whitney Mfg. Co.

CHUCKING Machines
Potter & Johnson Mch. Co.

CHUCKS, Automatic and Quick Changing
Errington Mech. Laboratory
Geometric Tool Co.
Modern Tool Works

CHUCKS, Collet
Sundstrand Machine Tool Co.

CHUCKS, Drill and Tap
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Morse Twist Drill & Mach. Co.

CHUCKS, Full Floating
Errington Mech. Laboratory

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City Machine and Tool Works

CHUCKS, Magnetic
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Whitney Mfg. Co.

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Oakite Products, Inc.

COMPOUNDS, Resin
Bakelite Corp.

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Oakite Products, Inc.

COMPRESSORS, Air and Gas
General Electric Co.

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Columbus Die Tool & Mach.
Commercial Centerless Grinding Co.
Eastern Machinery Co.
Greenlee Bros. and Co.
Hartford Special Mchy. Co.
Ingersoll Milling Machine Co.
Meisel Press Mfg. Co.
Rockford Iron Works
U. S. Tool Company, Inc.

CONTROLLERS and STARTERS, Electric
General Electric Co.

CONVERTERS
General Electric Co.

COUNTERBORES
Morse Twist Drill & Mach. Co.

COUNTERSHAFTS
Rivett Lathe & Grinder Corp.

COUNTERSINKS
Morse Twist Drill & Mach. Co.

COUNTERS and Counting Machines
Veeder-Root

COUPLINGS, Flexible
Boston Gear Wks. Sales Co.
Cullman Wheel Co.
Philadelphia Gear Works
Standard Pressed Steel Co.

CUTTERS, Gear
Morse Twist Drill & Mach. Co.
Union Twist Drill Co.

CUTTERS, Keyseater
Davis Keyseater Co.

CUTTERS, Milling
Barber-Colman Co.
Geometric Tool Co.
Ingersoll Milling Machine Co.
Modern Tool Works
Morse Twist Drill & Mach. Co.
National Tool Co.
Union Twist Drill Co.
Whitney Mfg. Co.

CUTTING-OFF Machines
Landis Machine Co.

CUTTING-OFF Tools
Prosser & Sons, Thos.

DEALERS, Machinery
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Cincinnati Machinery & Supply Co.
Delta Equipment Co.
De Witt Tool Co.
Eastern Machy. Co.
Emmerman & Co., Louis E.
Hyman & Sons, Jos.
Indianapolis Mach. & Sup. Co., Inc.
Iroquois Machinery Co.
McDonald Mchy. Co.
Miles Machinery Co.
Morey & Co., Inc.
Morris Machinery
O'Brien Machinery Co.
Price Battery Corp.
Seifriat-Elstad Machy. Co.
Seyferts Sons, Inc., L. F.
Simmons Machine Tool Corp.
Syracuse Supply Co.
Triangle Tool & Stamping Co.
Wigglesworth Machy. Co.

DEMAGNETIZERS
Walker Co., O. S.

DIE Holders for Presses
Baumbach Mfg. Co., E. A.
U. S. Tool Company, Inc.

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Baumbach Mfg. Co., E. A.
Danly Mach. Specialties, Inc.
U. S. Tool Company, Inc.

DIE Making Machines
Geo. Gorton Mach. Co.
Oliver Instrument Co.

DIE Sinking Machines
Preis. H. P.

DIE Sets
Baumbach Mfg. Co., E. A.
Danly Mach. Specialties, Inc.
U. S. Tool Company, Inc.

DIES, Adjustable and Self Opening
Eastern Mach. Screw Corp.
Errington Mech. Laboratory
Geometric Tool Co.
Landis Tool Co.
Murchey Mach. & Tool Co.

DIES, Sheet Metal and Sub-Press
(See Contract Work)

DRESSERS, Grinding Wheel
Norton Co.

DRILLING and Tapping Heads, Multiple
Errington Mech. Laboratory
Hoefer Mfg. Co.
U. S. Drill Head Co.

DRILLING Machines, Automatic
Barnes Drill Co.
Sundstrand Machine Tool Co.

DRILLING Machines, Automatic & Semi-Automatic
Barnes Drill Co.

DRILLING Machines, Bench
Barnes, W. F. and John Co.

DRILLING Machines, Gang
Baker Bros.
Barnes Drill Co.
Barnes, W. F. and John Co.
Foote-Burt Co.

DRILLING Machine Heads
Baker Bros.
U. S. Drill Head Co.

DRILLING Machines, Heavy Duty
Baker Bros.
Barnes Drill Co.
Barnes, W. F. and John Co.
Consolidated Mach. Tool Corp. of America
Foote-Burt Co.
Niles Tool Works Co.

DRILLING Machines, Radial
Carlton Mach. Tool Co.
Niles Tool Works Co.

DRILLING Machines, Sensitive
Barnes, W. F. and John Co.
High Speed Hammer Co.
Leland-Gifford Co.

DRILLING Machines, Upright Multiple Spindle
Baker Bros.
Barnes Drill Co.
Barnes, W. F. and John Co.
Consolidated Mach. Tool Corp. of America
Foote-Burt Co.
Grant Mfg. & Mch. Co.
Greenlee Bros. and Co.
Hoefer Mfg. Co.
Niles Tool Works Co.

DRILLING Machines, Vertical
Barnes Drill Co.
Barnes, W. F. and John Co.
Foote-Burt Co.
High Speed Hammer Co.
Hoefer Mfg. Co.
Leland-Gifford Co.

DRILLS, Center
Morse Twist Drill & Mach. Co.
Union Twist Drill Co.

DRILLS, Ratchet
Morse Twist Drill & Mach. Co.
Union Twist Drill Co.

DRILLS, Twist and Flat
Morse Twist Drill and Machine Co.

ELECTRICAL Instruments
General Electric Co.

ELECTRICAL Supplies
General Electric Co.

ENGRAVING Machinery
Geo. Gorton Mach. Co.
Preis, H. P., Engraving Mach. Co.

FANS, Electric
General Electric Co.

FELT, Washers, Pads, Wicks
Felters Co.

FILING Machines
Oliver Instrument Co.

FILTERS, Oil (See Oil Filtering)

FITTINGS, Hydraulic
Elmes Eng. Wks., Chas. F.

FLEXIBLE Shaft Equipment
Strand & Co., N. A.

FORGINGS Machinery
Acme Mchy. Co.

FURNACES, Forging
Hones, Chas. A.

FURNACES, Heat-Treating, Tempering & Annealing
American Gas Furnace Co.
General Electric Co.
Johnson Gas Appliance Co.
Strong, Carlisle & Hammond

FURNACES, Oil and Gas
Johnson Gas Appliance Co.

FURNACES, Soldering
Hones, Chas. A.

GAGES, Comparator
Federal Products Corp.

GAGES, Dial
Federal Products Corp.

GAGES, Snap, Thread and Cylindrical
Federal Products Corp.

GAGES, Standard
Federal Products Corp.

GEAR Blanks, Composition
Bakelite Corp.
Fellows Gear Shaper Co.
Waltham Mch. Works

GEAR Burnishing Machines
Gleason Works

GEAR Cutting Machines
Adams Co.
Barber-Colman Co.
Bilgram Gear & Machine Works
Gleason Works
National Tool Co.
Newark Gear Cutting Mach. Co.

GEAR Tempering Machines
Gleason Works

GEAR Testing Machinery
Ferner, R. Y. Co.
Gleason Works
National Tool Co.
Newark Gear Cutting Mach. Co.

GEARS, Cast
General Electric Co.
Grant Gear Works
Hartford Special Mchy. Co.
Philadelphia Gear Works

GEARS, Cut
Adams Co.
Bilgram Gear & Machine Works
Boston Gear Works, Sales Co.
Diefendorf Gear Corp.
Earle Gear & Machine Co.
Fellows Gear Shaper Co.
Gleason Works
Grant Gear Works
Hartford Special Mchy. Co.
Ingersoll Milling Machine Co.
Meisel Press Mfg. Co.
Niles Tool Works Co.
Philadelphia Gear Works

GENERATORS, Electric
General Electric Co.

GRINDING Machines, Bench
Norton Co.
Union Twist Drill Co.
Walker Co., O. S.

GRINDING Machines, Chaser
Geometric Tool Co.
Landis Machine Co.

GRINDING Machines, Chucking
Heald Machine Co.
Landis Tool Co.

GRINDING Machines, Cutter and Tool
Barber-Colman Co.
Cincinnati Milling Mach. Co.
Fafnir Bearing Co.
Geo. Gorton Mach. Co.
Heald Mach. Co.
Landis Tool Co.
National Tool Co.
Norton Co.
Oliver Instrument Co.
Sellers Co., Inc., Wm.
Union Twist Drill Co.
Walker Co., O. S.

GRINDING Machines, Cylinder
Heald Mach. Co.
Landis Tool Co.

GRINDING Machines, Cylindrical
Heald Mach. Co.
Landis Tool Co.
Norton Co.

GRINDING Machines, Die
Geometric Tool Co.
Heald Mach. Co.
Landis Machine Co.
Murchey Machine & Tool Co.
Walker Co., O. S.

GRINDING Machines, Disc
Peninsular Grinding Wheel Co.

GRINDING Machines, Face or Ring Wheel
Walker Co., O. S.

GRINDING Machines, Floor, no feed attachment
Norton Co.
Walker Co., O. S.

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Abrasive Machine Tool Co.
Ferner, R. Y. Co.
Landis Tool Co.
Norton Co.

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Heald Machine Co.

GRINDING Machines, Surface
Heald Mach. Co.
Norton Co.
Walker Co., O. S.

GRINDING Machines, Universal
Landis Tool Co.

GRINDING Wheels
Norton Co.
Sterling Grinding Wheel Co.

HAMMERS, Power
High Speed Hammer Co.
Niles Tool Works Co.
Sellers Co., Inc., Wm.

HANGERS, Shaft
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Shore Instrument & Mfg. Co.
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Philadelphia Gear Works

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Barnes Drill Co.
Hutto Engr. Co.

HYDRAULIC Machinery
Elmes Eng. Works, Chas. F.

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Federal Products Corp.

INDICATORS, Speed and Test
Veeder-Root

INSULATION, Sound and Vibration
Felters Co.

JIGS and Fixtures
(See Contract Work)

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Boston Gear Works Sales Co.

KEYS, Machine
Whitney Mfg. Co.

KEYS, Woodruff
Whitney Mfg. Co.

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Baker Bros.
Davis Keyseater Co.
Mitts & Merrill

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General Electric Co.

LATHE Attachments
Cullman Wheel Co.
Flather Co.

LATHE Tools
Prosser & Sons, Thos.

LATHE Wheels, R.R.
Schiess-Defries, A. G.

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Potter & Johnson Mch. Co.
Rockford Machine Tool Co.

LATHES, Axle R.R.
Niles Tool Works Co.
Sundstrand Machine Tool Co.

LATHES, Bench
Rivett Lathe & Grinder Corp.
Sidney Mach. Tool Co.

LATHES, Engine
Consolidated Mach. Tool Corp. of America
Flather Co.
Lodge & Shipley Mch. T. Co.
Monarch Machine Tool Co.
Niles Tool Works Co.
Sidney Mach. Tool Co.
Springfield Mach. Tool Co.
Sundstrand Machine Tool Co.

LATHES, Horizontal & Vertical Turret
Greenlee Bros. and Co.

LATHES, Toolroom
Lodge & Shipley Mach. Tool
Monarch Machine Tool Co.
Sidney Mach. Tool Co.
Springfield Mach. Tool Co.
Sundstrand Machine Tool Co.

LATHES, Wheel, R.R.
Niles Tool Works Co.
Sellers Co., Inc., Wm.

LEVEL Precision Machine Aligning
Ferner, R. Y. Co.

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Oakite Products, Inc.

LUBRICATING Systems
Rivett Lathe & Grinder Corp.

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(See Arbors and Mandrels)

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Preis, H. P. Engraving Mach. Co.

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Ferner, R. Y. Co.

MELTING Pots
Hones, Chas. A.

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Ferner, R. Y. Co.

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Ingersoll Milling Machine Co.
Potter & Johnson Mch. Co.
Sundstrand Machine Tool Co.

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Cincinnati Milling Mach. Co.
Ingersoll Milling Machine Co.
Sundstrand Machine Tool Co.

MILLING Machines, Bench
Sundstrand Machine Tool Co.

MILLING Machines, Continuous
Consolidated Mach. Tool Corp. of America
Ingersoll Milling Machine Co.
Potter & Johnson Mch. Co.
Sundstrand Machine Tool Co.

MILLING Machines, Duplex
Cincinnati Milling Mach. Co.
Ingersoll Milling Machine Co.

MILLING Machines, Floor Type
Sellers Co., Inc., Wm.

MILLING Machines, Hand
Cincinnati Milling Mach. Co.

MILLING MACHINES, Plain
Cincinnati Milling Mach. Co.
Ingersoll Milling Machine Co.
Potter & Johnson Mch. Co.
Sidney Mach. Tool Co.
Sundstrand Machine Tool Co.

MILLING Machines, Planer Type
Consolidated Mach. Tool Corp. of America
Ingersoll Milling Machine Co.
Niles Tool Works Co.
Sellers Co., Inc., Wm.

MILLING Machines, Portable
Ingersoll Milling Machine Co.

MILLING Machines, Thread
Adams Co.

MILLING Machines, Universal
Cincinnati Milling Mach. Co.
Gorton Machine Co., Geo.
Ingersoll Milling Machine Co.
Potter & Johnson Mch. Co.
Sidney Mach. Tool Co.
Sundstrand Machine Tool Co.

MILLING Machines, Vertical
Cincinnati Milling Mach. Co.
Consolidated Mach. Tool Corp. of America
Geo. Gorton Mach. Co.
Ingersoll Milling Machine Co.
Potter & Johnson Mch. Co.
Preis, H. P.
Sidney Mach. Tool Co.
Sundstrand Machine Tool Co.

MOTORS, Electric
Greenlee Bros. and Co.

NUT Tappers
(See Bolt & Nut Machinery)

OIL and Grease Cups
Gits Bros. Mfg. Co.

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OIL Stones
Norton Co.

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(See Woodworking Machinery)

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PLANING Machines
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Niles Tool Works
Rockford Machine Tool Co.
Sellers Co., Inc., Wm.

PLATING, Chromium
United Chromium, Inc.

POLISHING and Buffing Machines
Heald Mach. Co.
Landis Tool Co.
Union Twist Drill Co.

PRESS Feeds
V. & O. Press Co.

PRESSES, Arbor
Barnes, W. F. and John Co.

PRESSES, Drop & Forging
Toledo Mach. & Tool Co.

PRESSES, Forcing
Barnes, W. F. and John Co.
Elmes Eng. Works, Chas. F.

PRESSES, Hydraulic
Elmes Eng. Works, Chas. F.

PRESSES, Power
Niagara Machine and Tool Works
Toledo Mach. & Tool Co.
V. & O. Press Co.

PRESSES, Screw
Barnes, W. F. and John Co.

PROFILING Machine
Geo. Gorton Mach. Co.

PUMPS, Hydraulic and Power
Elmes Eng. Works, Chas. F.

PUNCHES, Center & Hand
Armstrong-Blum Mfg. Co.

PUNCHES, Power
Mitts & Merrill

PUNCHING and Shearing Machines
Consolidated Mach. Tool Corp. of America

REAMERS, Adjustable
Barber-Colman Co.
Gammons-Holman Co.
Morse Twist Drill & Mach. Co.

REAMERS, Solid
Barber-Colman Co.
Gammons-Holman Co.
Morse Twist Drill & Mach. Co.
Union Twist Drill Co.

RHEOSTATS
General Electric Co.

RIVETING Machines
Grant Mfg. & Machine Co.
High Speed Hammer Co.

RODS, Copper, Brass & Bronze
American Brass Co.

RUST, Preventives
Oakite Products, Inc.

SAWING Machines, Band
Armstrong-Blum Mfg. Co.

SAWING Machines, Power Hack
Armstrong-Blum Mfg. Co.
Earle Gear & Mach. Co.
Victor Saw Works

SAWS, Band
Victor Saw Works

SAWS, Hack, Frames and Blades
Armstrong-Blum Mfg. Co.
Victor Saw Works

SAWS, Milling
Barber-Colman Co.
Union Twist Drill Co.

SAWS, Screw Slotting
Union Twist Drill Co.

SCREW Drivers, Automatic
Errington Mech. Laboratory

SCREW-MACHINE Work
Eastern Mch. Screw Corp.

SCREW Machines, Automatic
Cone Auto. Mch. Co.
Greenlee Bros. & Co.

SCREW Plates
Card Mfg. Co., S. W.

SCREWS, Cap and Set
Allen Mfg. Co.
Danly Mach. Specialties, Inc.
Eastern Mch. Screw Corp.
Strong, Carlisle & Hammond

SCREWS, Machine
Allen Mfg. Co.
Eastern Mach. Screw Corp.

SCREWS, Safety
Strong, Carlisle & Hammond

SECOND-HAND Machinery
(See Searchlight Section)
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Cincinnati Machinery & Supply Co.
Delta Equipment Co.
De Witt Tool Co.
Eastern Machy. Co.
Emmerman & Co., Louis E.
Hyman & Sons, Jos.
Indianapolis Mach. & Sup. Co., Inc.
Iroquois Machinery Co.
McDonald Mchy. Co.
Miles Machinery Co.
Morey & Co., Inc.
Morris Machinery
O'Brien Machinery Co.
Price Battery Corp.
Seifriat-Elstad Machy. Co.
Seyferts Sons, Inc., L. F.
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Syracuse Supply Co.
Triangle Tool & Stamping Co.
Wigglesworth Machy. Co.

SHAPERS
Potter & Johnson Mch. Co.
Rockford Machine Tool Co.
Springfield Mach. Tool Co.

SHEARS, Power
Consolidated Mach. Tool Corp. of America
Mitts & Merrill
Toledo Mach. & Tool Co.

SHEET Metal Working Machinery
Toledo Mach. & Tool Co.

SHEETS, Copper, Brass & Nickel Silver
American Brass Co.

SLOTTING Machines
Consolidated Mach. Tool Corp. of America

SPECIAL Machinery and Tools
(See Contract Work)

SPEED Box, Motor Drive
Rivett Lathe & Grinder Corp.

SPEED Reducers
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Cullman Wheel Co.
Earle Gear & Machine Co.
Grant Gear Works
Hartford Special Mchy. Co.
Philadelphia Gear Works

SPRINGS
Philadelphia Gear Works

SPROCKETS
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Boston Gear Works Sales Co.
Cullman Wheel Co.
Grant Gear Works
Philadelphia Gear Works
Whitney Mfg. Co.

STARTERS—Automatic A.C. and D.C.
(See Controller & Starters, Electric)

STEELS, Alloy, Carbon and High Speed
Latrobe Electric Steel Co.
Timken Roller Bearing Co.
Vickers, Inc.

STEELS, Rustless & Stainless

STRAIGHTENING Machinery
Springfield Mach. Tool Co.

STUD Setters
Errington Mech. Laboratory

SUB Presses and Dies
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U. S. Tool Co.

SWAGING Machines
Torrington Co.

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Allen Mfg. Co.

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Walton Co.

TAP Holders
Errington Mech. Laboratory

TAPER Pins
Morse Twist Drill & Mach. Co.

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Baker Bros.
Barber-Colman Co.
Barnes Drill Co.
Errington Mech. Laboratory
Geometric Tool Co.
Greenlee Bros. & Co.
Murchey Mach. & Tool Co.

TAPPING Machines, Cylindrical and Flat
Norton Co.

TAPS and Dies
Card Mfg. Co., S. W.
Landis Machine Co.
Morse Twist Drill & Mach. Co.
Murchey Mach. & Tool Co.

TAPS, Collapsing
Eastern Mch. Screw Corp.
Geometric Tool Co.
Landis Machine Co.
Modern Tool Works
Murchey Mach. & Tool Co.

TAPS, Ground
Morse Twist Drill & Mach. Co.

TEMPERING Compounds
(See Case Hardening, etc.)

TESTING Apparatus, Hardness
Shore Instrument & Mfg. Co.
Wilson Mechanical Instrument Co.

THREAD-Cutting Machines
Eastern Mch. Screw Corp.
Ferner, R. Y. Co.
Geometric Tool Co.
Grant Mfg. & Mch. Co.
Landis Machine Co.
Murchey Mach. & Tool Co.

THREAD-Cutting Tools
Eastern Mch. Screw Corp.
Geometric Tool Co.
Landis Machine Co.
Murchey Mach. & Tool Co.

TOOL Bits
Prosser & Sons, Thos.

TOOLS, Cutting-Off
Prosser & Sons, Thos.

TOOL Work
(See Contract Work)

TOOLS, Carbide Tungsten
Prosser & Sons, Thos.

TRANSFORMERS
General Electric Co.

TRANSMISSION Equipment
Boston Gear Works Sales Co.
Whitney Mfg. Co.

TUBES & Tubing, Copper, Brass, Bronze & Alloy
American Brass Co.

TUBING, Brass, Bronze, Copper, Seamless
Timken Roller Bearing Co.

TURBINES, Steam
General Electric Co.

TURRET Machines
(See Lathes, Horizontal Turret)

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VISES, Milling Machine
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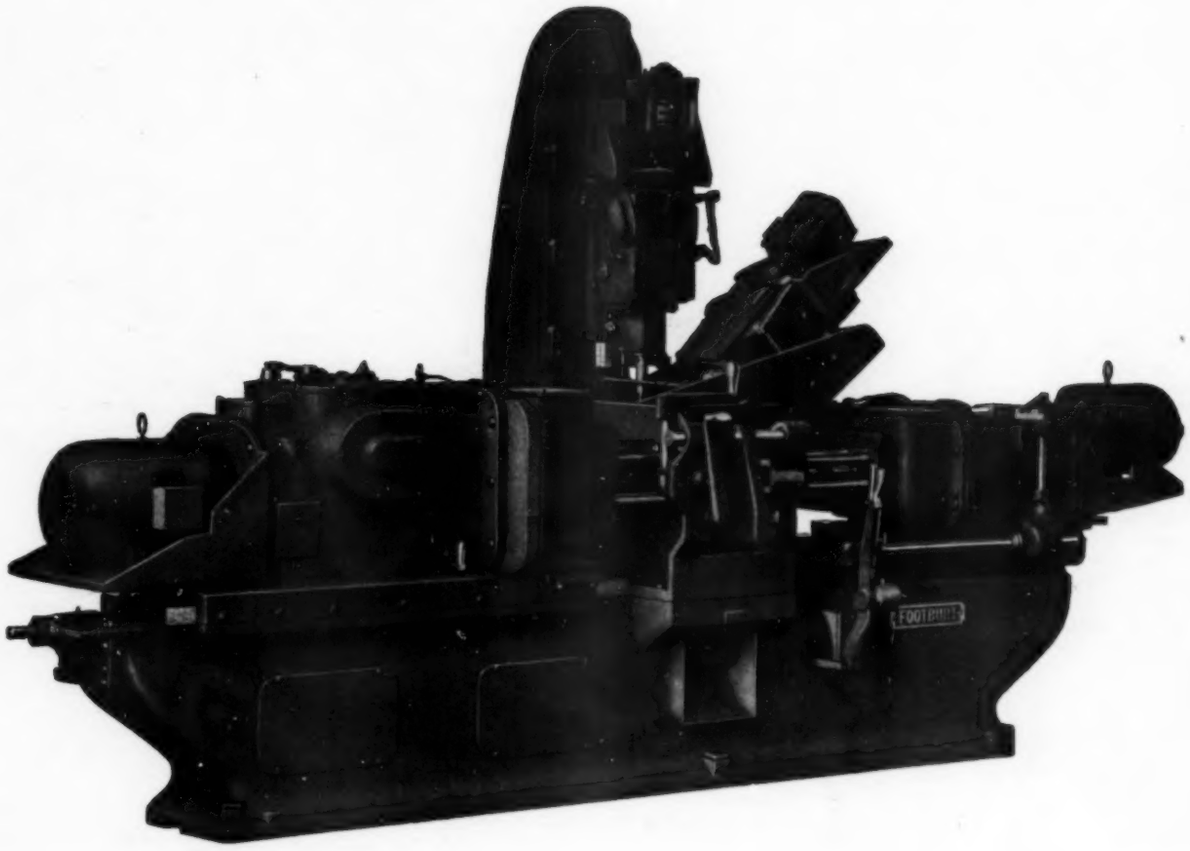
FOOTBURT

WAY DRILLS



Solving another drilling problem, this Footburt machine illustrates the flexibility possible in making up way drilling equipment.

The units of this machine are placed in the most advantageous position and the size of each unit is in proportion to the travel required and the amount of metal removed. The right hand head has nine spindles and is mounted on a 10" diameter cam unit. The left hand head drills twenty-three holes and is mounted on a 14" diameter cam unit. Both the vertical and angular units have 6" diameter cams. Each carries a single spindle head.

If you have a difficult drilling problem, why not consult Footburt on way drilling equipment? We will be glad to work with you. Just write.

THE FOOTE-BURT COMPANY • CLEVELAND, OHIO

Detroit Office: 4-151 General Motors Building Chicago Office: 565 Washington Boulevard

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